BSM- 4101A
BSM- 4102A
BSM- 4103A
BSM- 4104A
BSM- 4111A
BSM- 4112A
BSM- 4113A
BSM- 4114A

Life Scope P
BEDSIDE MONITOR

BSM-4100A

0614-005992H

Model: BSM-4100A

Manual code no.: 0614-005992H

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GENERAL HANDLING PRECAUTIONS

This device is intended for use only by qualified medical personnel.
Use only Nihon Kohden approved products with this device. Use of non-approved products or in a non-approved manner may affect the performance specifications of the device. This includes, but is not limited to, batteries, recording paper, pens, extension cables, electrode leads, input boxes and AC power.

Please read these precautions thoroughly before attempting to operate the instrument.

1. **To safely and effectively use the instrument, its operation must be fully understood.**

2. **When installing or storing the instrument, take the following precautions:**
   (1) Avoid moisture or contact with water, extreme atmospheric pressure, excessive humidity and temperatures, poorly ventilated areas, and dust, saline or sulphuric air.
   (2) Place the instrument on an even, level floor. Avoid vibration and mechanical shock, even during transport.
   (3) Avoid placing in an area where chemicals are stored or where there is danger of gas leakage.
   (4) The power line source to be applied to the instrument must correspond in frequency and voltage to product specifications, and have sufficient current capacity.
   (5) Choose a room where a proper grounding facility is available.

3. **Before Operation**
   (1) Check that the instrument is in perfect operating order.
   (2) Check that the instrument is grounded properly.
   (3) Check that all cords are connected properly.
   (4) Pay extra attention when the instrument is combined with other instruments to avoid misdiagnosis or other problems.
   (5) All circuitry used for direct patient connection must be doubly checked.
   (6) Check that battery level is acceptable and battery condition is good when using battery-operated models.

4. **During Operation**
   (1) Both the instrument and the patient must receive continual, careful attention.
   (2) Turn power off or remove electrodes and/or transducers when necessary to assure the patient's safety.
   (3) Avoid direct contact between the instrument housing and the patient.

5. **To Shutdown After Use**
   (1) Turn power off with all controls returned to their original positions.
   (2) Remove the cords gently; do not use force to remove them.
   (3) Clean the instrument together with all accessories for their next use.

6. **The instrument must receive expert, professional attention for maintenance and repairs. When the instrument is not functioning properly, it should be clearly marked to avoid operation while it is out of order.**

7. **The instrument must not be altered or modified in any way.**

8. **Maintenance and Inspection:**
   (1) The instrument and parts must undergo regular maintenance inspection at least every 6 months.
   (2) If stored for extended periods without being used, make sure prior to operation that the instrument is in perfect operating condition.
   (3) Technical information such as parts list, descriptions, calibration instructions or other information is available for

qualified user technical personnel upon request from your Nihon Kohden distributor.

9. **When the instrument is used with an electrosurgical instrument, pay careful attention to the application and/or location of electrodes and/or transducers to avoid possible burn to the patient.**

10. **When the instrument is used with a defibrillator, make sure that the instrument is protected against defibrillator discharge. If not, remove patient cables and/or transducers from the instrument to avoid possible damage.**

WARRANTY POLICY

Nihon Kohden Corporation (NKC) shall warrant its products against all defects in materials and workmanship for one year from the date of delivery. However, consumable materials such as recording paper, ink, stylus and battery are excluded from the warranty.

NKC or its authorized agents will repair or replace any products which prove to be defective during the warranty period, provided these products are used as prescribed by the operating instructions given in the operator's and service manuals.

No other party is authorized to make any warranty or assume liability for NKC's products. NKC will not recognize any other warranty, either implied or in writing. In addition, service, technical modification or any other product change performed by someone other than NKC or its authorized agents without prior consent of NKC may be cause for voiding this warranty.

Defective products or parts must be returned to NKC or its authorized agents, along with an explanation of the failure. Shipping costs must be pre-paid.

This warranty does not apply to products that have been modified, disassembled, reinstalled or repaired without Nihon Kohden approval or which have been subjected to neglect or accident, damage due to accident, fire, lightning, vandalism, water or other casualty, improper installation or application, or on which the original identification marks have been removed.

In the USA and Canada other warranty policies may apply.

CAUTION

United States law restricts this device to sale by or on the order of physician.

EMC RELATED CAUTION

This equipment and/or system complies with the International Standard IEC60601-1-2 for electromagnetic compatibility for medical electrical equipment and/or system. However, an electromagnetic environment that exceeds the limits or levels stipulated in the IEC60601-1-2, can cause harmful interference to the equipment and/or system or cause the equipment and/or system to fail to perform its intended function or degrade its intended performance. Therefore, during the operation of the equipment and/or system, if there is any undesired deviation from its intended operational performance, you must avoid, identify and resolve the adverse electromagnetic effect before continuing to use the equipment and/or system.

The following describes some common interference sources and remedial actions:

1. **Strong electromagnetic interference from a nearby emitter source such as an authorized radio station or cellular phone:**
   Install the equipment and/or system at another location if it is interfered with by an emitter source such as an authorized radio station. Keep the emitter source such as cellular phone away from the equipment and/or system.

2. **Radio-frequency interference from other equipment through the AC power supply of the equipment and/or system:**
   Identify the cause of this interference and if possible remove this interference source. If this is not possible, use a different power supply.

3. **Effect of direct or indirect electrostatic discharge:**
   Make sure all users and patients in contact with the equipment and/or system are free from direct or indirect electrostatic energy before using it. A humid room can help lessen this problem.

4. **Electromagnetic interference with any radio wave receiver such as radio or television:**
   If the equipment and/or system interferes with any radio wave receiver, locate the equipment and/or system as far as possible from the radio wave receiver.

If the above suggested remedial actions do not solve the problem, consult your Nihon Kohden Corporation subsidiary or distributor for additional suggestions.

This equipment complies with International Standard IEC60601-1-2 (1993) which requires CISPR11, Group 1, Class B. Class B EQUIPMENT is equipment suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

In IEC 60601-1-2 Medical Electronic Equipment, Part 1: General Requirements for Safety, 2. Collateral Standard: Electromagnetic compatibility-Requirements and test. Section 36. 202. 2 Radiated radio-frequency electromagnetic fields, PATIENT COUPLED EQUIPMENT and/or SYSTEMS applicable IMMUNITY test methods are under consideration at SC62A/WG13. The 3 V/m IMMUNITY level may be inappropriate especially when measuring SpO_2 because physiological signals can be much smaller than those induced by a 3 V/m electromagnetic field.

When measuring SpO_2, various interference may produce false waveforms which look like pulse waveforms. SpO_2 value and pulse rate may be measured from these false waveforms, causing the alarm to function improperly.

When installing the monitor, avoid locations where the monitor may receive strong electromagnetic interference such as radio or TV stations, cellular phone or mobile two-way radios.

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment*

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. If this occurs, disconnect the monitor or diagnostic equipment from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden distributor.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the patient, resulting in an elevated pacing rate.

For more information, see the FDA web site.
http://www.fda.gov/cdrh/safety.html

Conventions Used in this Manual and Instrument

Warnings, Cautions and Notes

Warnings, cautions and notes are used in this manual to alert or signal the reader to specific information.

WARNING

A warning alerts the user to possible injury or death associated with the use or misuse of the instrument.

CAUTION

A caution alerts the user to possible injury or problems with the instrument associated with its use or misuse such as instrument malfunction, instrument failure, damage to the instrument, or damage to other property.

NOTE

A note provides specific information, in the form of recommendations, prerequirements, alternative methods or supplemental information.

Explanations of the Symbols in this Manual and Instrument

The following symbols found in this manual/instrument bear the respective descriptions as given.

On panels

Symbol	Description	Symbol	Description
	Standby		Defibrillation-proof type CF applied part
	“On” only for a part of instrument		Defibrillation-proof type BF applied part
	“Off” only for a part of instrument		Type CF applied part
	Battery		Type BF applied part
	Battery charging		Data input/output
	Record start/stop		Input/output terminal
	Out of paper		Alternating current
	Alarm suspend		Equipotential terminal
	NIBP		Remote terminal
	NIBP interval		Year of manufacture
	NIBP start		Serial number
	NIBP stop		Protective earth
	Menu		High voltage
	Home (monitoring screen)		Attention, consult operator’s manual
	Output		

On screen

Symbol	Description	Symbol	Description
	Alarm suspend with remaining minutes		QRS/pulse sync mark
	Alarm off		Respiration sync mark
	Alarm recording off		Value out of range
	Recording		Current measuring value
	Paper magazine open		Adjust setting/Scroll data
	Out of paper		Touch screen calibration mark
	Printer (when QI-111P network printer card is used)		Change scale
			Network communicating (when QI-101P network card is used)

Others

Symbol	Description
	Recycle (On battery pack)

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Section 1 provides a general overview of the equipment and how to operate it. If you have not used a BSM-4100A bedside monitor before, read this section first.

- Features
- Components in the system
- Panel descriptions
- Screen displays
- Basic operation concepts
- Important safety information

Introduction

The Life Scope P BSM-4101A, BSM-4102A, BSM-4103A, BSM-4104A, BSM-4111A, BSM-4112A, BSM-4113A and BSM-4114A hardwire bedside monitors have several connectors for ECG, impedance method respiration, SpO_2 and NIBP monitoring and multi-parameter sockets for IBP, temperature, thermistor method respiration, CO, CO_2 and FiO_2 monitoring. Its easy operation and compact lightweight design lets you use this bedside monitor in the general ward, ICU, CCU, operating room and for patient transportation. For portability, it can operate on battery power as well as AC power.

For simplicity, the suffix A will be omitted in this manual. There is no difference in operation among models with different suffixes unless otherwise specified.

NOTE

Use only Nihon Kohden parts and accessories to assure maximum performance from your instrument.

Features

- **Hardwire system**
  Monitors ECG, impedance method respiration, SpO_2 and NIBP. With the multi-parameter sockets, IBP, temperature, thermistor method respiration, CO, CO_2 or FiO_2 can be monitored.
  Difference between the models are:

Model	BSM-4101	BSM-4102	BSM-4103	BSM-4104	BSM-4111	BSM-4112	BSM-4113	BSM-4114
No. of multi-parameter sockets	2		3		2		3	
Recorder	Yes				No			
Simultaneous ECG leads	1		12		1		12	
12 lead ECG interpretation (ECAPS 12C)	No		Yes		No		Yes	
SpO_2 probe	Nihon Kohden's	Nellcor's	Nihon Kohden's	Nellcor's	Nihon Kohden's	Nellcor's	Nihon Kohden's	Nellcor's
NIBP PWTT measurement	Yes	No	Yes	No	Yes	No	Yes	No
HEMO LIST window	No		Yes		No		Yes	
Drug calculation	No		Yes		No		Yes	

- **AC or battery operation**
  The monitor can operate on AC power or battery for up to 1 hour.

- **Color data display**
  Detailed information is displayed on the wide angle, 12.1 inch color LCD. Monitoring parameters are automatically identified.

- **Easy operation by the hard keys and touch screen keys**
  The monitor can be operated using the touch keys on the screen, as well as the hard keys on the panel.

- **Highly reliable ECG monitoring**
  Arrhythmia can be analyzed and ST level can be measured. The dominant QRS can be changed any time for template-matching analysis of arrhythmia and measuring condition for ST level can be changed.
  On the BSM-4103/4104/4113/4114 monitors, 12 lead can be displayed on the screen when monitoring with 10 electrodes. The 12 lead ECG interpretation can be performed on these ECG waveforms.

- **Review windows for viewing saved data**
  Saved data can be displayed on the trend window, list window, arrhythmia recall window and alarm history window. With the optional QM-421P flash disk card, full disclosure and ST level recall waveforms can be saved. On the BSM-4103/4104/4113/4114 monitors, hemodynamics list window is available for CO measurement.

- **Function keys**
  There are three function keys at the upper left corner of the screen. A function can be assigned to each key, for example, freezing waveforms and displaying the MENU window.

- **Built-in thermal array recorder with 50 mm width paper (BSM-4101/4102/4103/4104 only)**
  Waveforms, numeric data, trendgraphs, and vital signs lists can be recorded manually or automatically.

- **Telemetry system (option)**
  When the optional ZB-800P transmitter is connected to the bedside monitor, waveform(s) and parameter data from the bedside monitor can be sent to a Cardiac Telemetry System or to a Central Monitor via Multiple Patient Receiver and recorded. (Available waveforms and parameter data depend on the receiving monitor. CO and FiO_2 data cannot be transmitted.) The ZB-800P transmitter is 400MHz only.

- **Central monitor connection (option)**
  When the optional QI-101P network card is inserted into the bedside monitor, the bedside monitor can be connected to the central monitor in the network. Waveforms and data of the bedside monitor can be sent to the central monitor. An interbed alarm of any patient in the same network can be displayed on the bedside monitor.

- **Wireless LAN system (option)**
  When the optional QI-410P wireless LAN station is connected to the bedside monitor and when there are several QI-902R wireless access points installed in the facility, the signal from the bedside monitor can be received by radio communication with the wireless LAN access point. The wireless LAN access point is connected to the central monitor network. For details, contact your Nihon Kohden distributor.

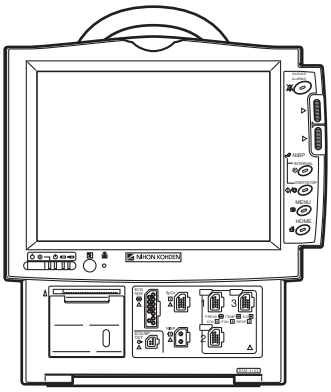
- **Printing on a Network Printer (option)**
  When the optional QI-111P network printer card is inserted into the bedside monitor, the data on the review windows, 12 lead ECG interpretation data (BSM-4103/4104/4113/4114 monitors only) and waveforms and numeric data of the monitoring parameters can be printed on a network printer.

- **Anesthesia monitoring (option)**
  When the optional AG-920R multigas unit is connected to the monitor, the anesthetic gas can be monitored. To connect the multigas unit, the optional YJ-921P connection cable or QI-401P interface is required. For details, refer to the AG-920RA/RK multigas unit manual.

- **Sidestream CO_2 monitoring (option)**
  When the optional AG-400R CO_2 unit is connected to the monitor, the CO_2 by sidestream method can be monitored. To connect the CO_2 unit, the optional YJ-921P connection cable or QI-401P interface is required. For details, refer to the AG-400RA/RK CO_2 unit manual.

- **Continuous NIBP monitoring (option)**
  When the optional AP-400R non-invasive blood pressure unit is connected to the monitor, continuous NIBP can be measured. To connect the non-invasive blood pressure unit, the optional YJ-921P connection cable or QI-401P interface is required. For details, refer to the AP-400RA/RK non-invasive blood pressure unit manual. The CNIBP data cannot be sent to the central monitor when it is connected to the central monitor network.

Composition



Life Scope P Bedside Monitor
BSM-4101, BSM-4102, BSM-4103
BSM-4104, BSM-4111, BSM-4112
BSM-4113, BSM-4114

Cart, KC-009P (option)

Interface for connecting display and optional unit, QI-401P (option)

Interface for connecting BIS monitor, QI-402P (option)

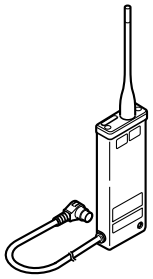
Interface for connecting Drager ventilator, QI-403P (option)

Interface for connecting Servo300 ventilator, QI-404P (option)

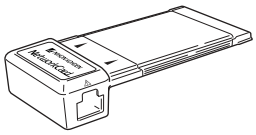
Interface for connecting Oridion Microcap, QI-405P (option)

Interface for connecting Puritan Bennett ventilator, QI-406P (option)

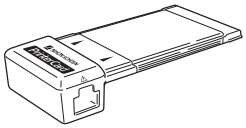
Interface for connecting Siemens ventilator Servo i, QI-408P (option)



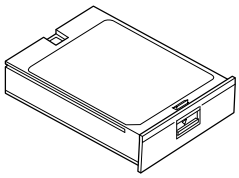
Transmitter (option)
ZB-800P (400MHz only)



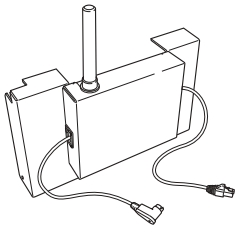
Network Card (option)
QI-101P



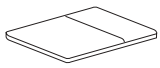
Network Printer Card (option)
QI-111P



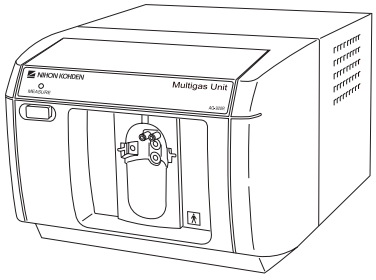
Battery pack (option)
NKB-101



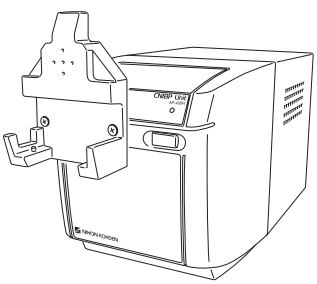
Wireless LAN Station (option)
QI-410P



Flash Disk Card (option)
QM-421P



Multigas unit (option)
AG-920R



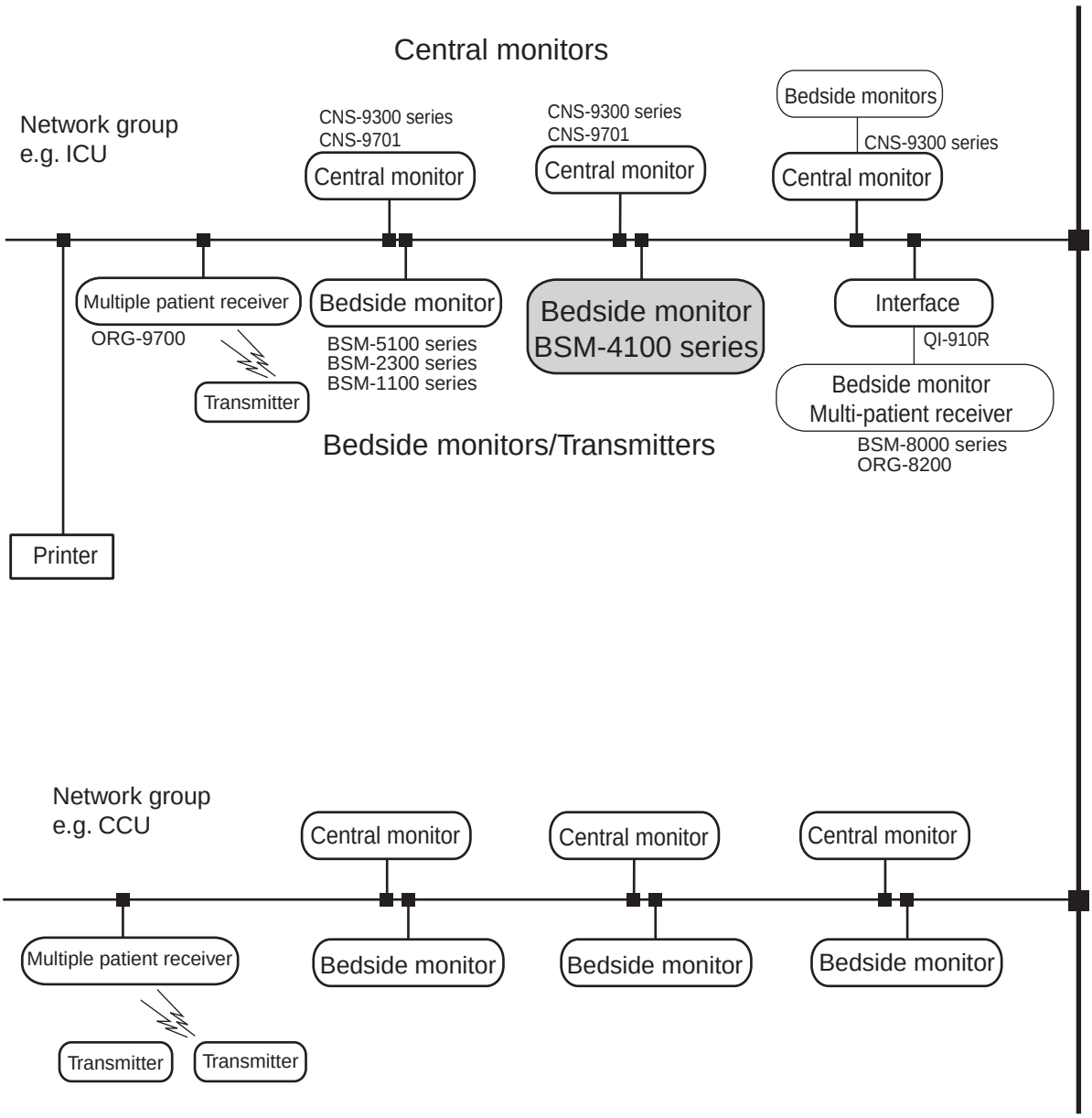
Non-invasive blood pressure unit (option)
AP-400R

Network Composition

In a central monitor network, on a central monitor, you can see data of any bed in the network.

The data that can be displayed on the bedside monitor or central monitor depends on the type of bedside or central monitor used.

The number of central monitors and bedside monitors that can be connected to a central monitor network and the network communication method depend on the type of monitor used. For details, refer to the Network and System Installation Guide.

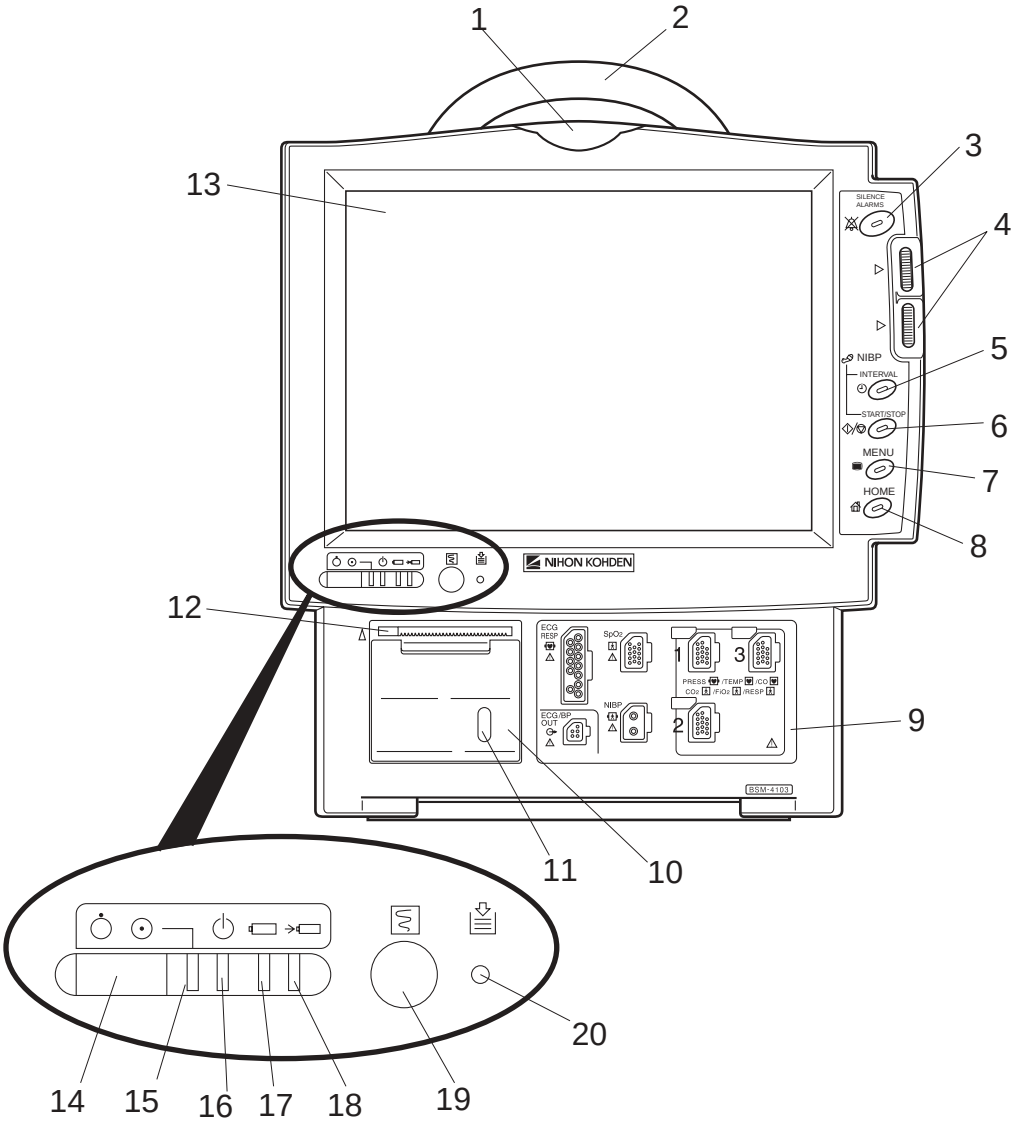


WARNING

- **Install the printer and hubs outside the patient environment. If they are installed inside the patient environment, the patient or operator may receive electrical shock.**
- **Check the software version number of the monitor before connecting it to the network. Different software versions have different communication methods. When there is more than one communication method in the network, communication may malfunction.**

Panel Description

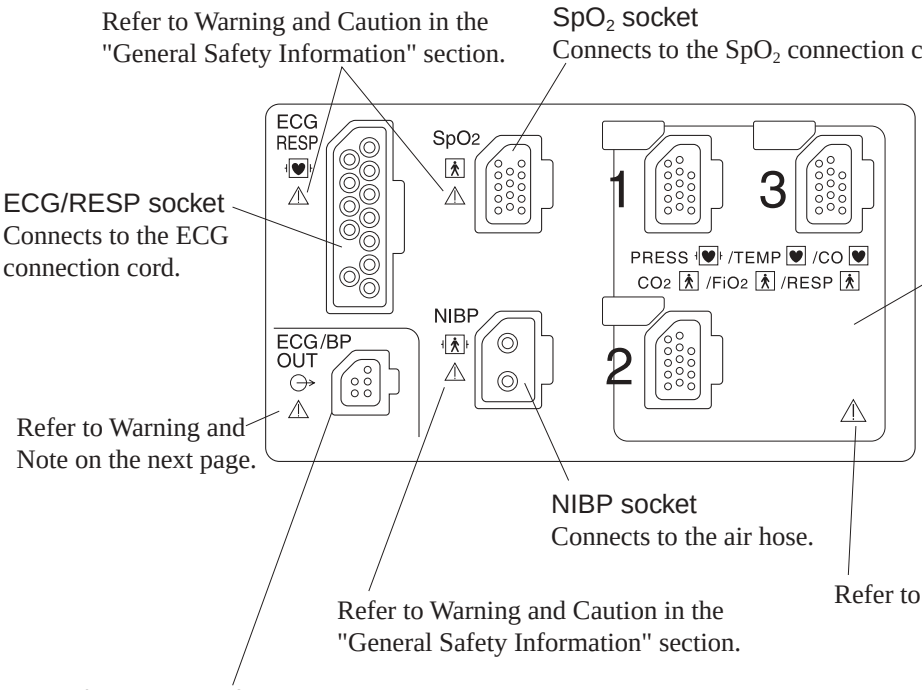
Front Panel



No.	Name	Description
1	Alarm indicator	Red or yellow lamp blinks according to the alarm settings. Green lamp blinks in synchronization with the patient's QRS.
2	Handle	For carrying the monitor.
3	SILENCE ALARMS key	Silences the alarm sound.
4	Function dial 1 and 2	Used for setting alarm limits and scrolling list or trendgraphs. When the function dial lamp lights, the function dial is available.
5	NIBP INTERVAL key	Selects NIBP measurement mode. Pressing this key changes the mode.
6	NIBP START/STOP key	Starts NIBP measurement in selected mode. Pressing the key during measurement stops measurement.
7	MENU key	Displays the MENU window.
8	HOME key	Closes any opened window and displays the monitoring screen.
9	Socket panel	Refer to the "Socket Panel" section.
10	Paper magazine	Holds recording paper. (BSM-4101/4102/4103/4104 only)
11	Paper window	For checking the amount of recording paper. (BSM-4101/4102/4103/4104 only)
12	Paper magazine release lever	Pull up the lever to open the paper magazine. (BSM-4101/4102/4103/4104 only)
13	Touch screen	Displays monitoring data. Touching a key or data on the screen changes displaying screen and settings.
14	Power switch	Press and hold for more than one second to turn the monitor power on or off.
15	Power lamp	Lights when the monitor power is turned on.
16	AC power lamp	Lights when the power cord is connected between the AC SOURCE socket and AC outlet.
17	Battery power lamp	Lights when operating on the battery power.
18	Battery charging lamp	Lights or slowly blinks when charging.
19	Record key	Press to start or stop recording.
20	Out of paper lamp	Blinks when out of paper. Lights when paper magazine is open. (BSM-4101/4102/4103/4104 only)

Socket Panel

On the BSM-4101/4103/4111/4113 Monitors



Refer to Warning and Caution in the "General Safety Information" section.

SpO_2 socket
Connects to the SpO_2 connection cord.

ECG/RESP socket
Connects to the ECG connection cord.

Multi-parameter sockets
Connects to the connection cord of the parameter to be monitored (IBP, temperature, CO, CO_2, FiO_2 or respiration by thermistor method). The type of parameter is automatically recognized. BSM-4101/4111 monitors have two sockets and BSM-4103/4113 monitors have three sockets.

Refer to Warning and Note on the next page.

NIBP socket
Connects to the air hose.

Refer to Warning and Note on the next page.

Refer to Warning and Caution in the "General Safety Information" section.

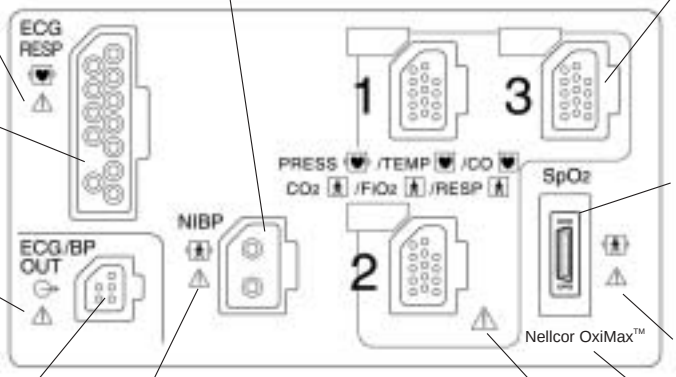
ECG/BP OUT socket
Outputs 100 mmHg/V IBP waveform of the IBP connected to the multi-parameter 1 socket, 1 mV/V ECG waveform and heart rate trigger by using the YJ-910P or YJ-920P ECG/BP output cable. These analog signals can be used as the synchronization signal for other equipment, such as IABP. Refer to the warning on the next page.

On the BSM-4102/4104/4112/4114 Monitors

Multi-parameter sockets
Connect to the connection cord of the parameter to be monitored (IBP, temperature, CO, CO_2, FiO_2 or respiration by thermistor method). The type of parameter is automatically recognized. BSM-4102/4112 monitors have two sockets and BSM-4104/4114 monitors have three sockets.

NIBP socket
Connects to the air hose.

Refer to Warning and Caution in the "General Safety Information" section.



ECG/RESP socket
Connects to the ECG connection cord.

Refer to Warning and Note on the next page.

SpO_2 socket
Connects to the SpO_2 connection cord.

Refer to Warning and Caution in the "General Safety Information" section.

Refer to "Nellcor SpO_2 Probes for the BSM-4102/4104/4112/4114 Monitors" in Section 13.

Refer to Warning and Caution in the "General Safety Information" section.

ECG/BP OUT socket
Outputs 100 mmHg/V IBP waveform of the IBP connected to the multi-parameter 1 socket, 1 mV/V ECG waveform and heart rate trigger by using the YJ-910P or YJ-920P ECG/BP output cable. These analog signals can be used as the synchronization signal for other equipment, such as IABP. Refer to the warning on the next page.

Refer to Warning and Note on the next page.

Using the Output Signal from the ECG/BP OUT Socket

WARNING

When using the output signal from the monitor as the synchronization signal for other equipment such as IABP (intra-aortic balloon pump) or defibrillator:

- **Set the timing of the other equipment by checking the waveform on the monitoring screen.**
- **Check the condition of the bedside monitor at all times. The output signal may become unstable.**
- **Check that the delay time of the output signal (heart rate trigger 64 ms maximum) is within the range of the connected equipment.**
- **Do not use the heart rate trigger as the synchronization signal for defibrillator.**

NOTE

The output signal from the ECG/BP OUT socket may become unstable in the following conditions.

- **Electrode is dry or detached.**
- **Electrode lead is damaged or disconnected from the electrode.**
- **Electrode lead is pulled.**
- **AC interference or EMG noise superimposed.**
- **Air bubbles or blood clog in the circuit for monitoring IBP.**
- **Cord or cable is disconnected or damaged.**

The Delay Time of the Output Signal

Output Signal	Filter Setting	Delay Time
ECG	Hum filter OFF	2 ms
	Hum filter ON	10 ms
IBP	Filter 20 Hz	30 to 35 ms
Heart rate trigger	———	32 to 64 ms

Using Multi-parameter Sockets for CO and CO_2 Monitoring

WARNING

- **When performing defibrillation during CO monitoring, never touch the CO connection cord. Otherwise the discharged energy may cause serious electrical burn, shock or other injury.**
- **When performing defibrillation during CO_2 monitoring with the CO_2 sensor kit, remove the sensor from the patient. When the sensor cannot be removed, do not touch the sensor cable because the discharged energy may cause serious electrical burn, shock or other injury.**

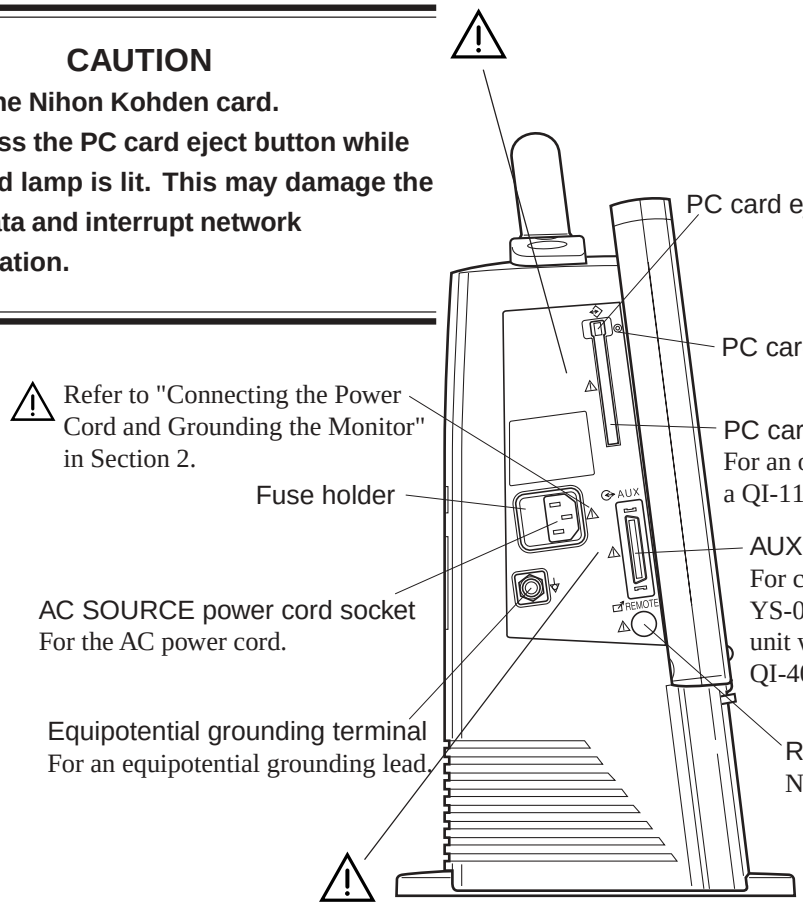
NOTE

- **CO monitoring using the multi-parameter socket does not comply with the Defibrillator proof type CF.**
- **CO_2 monitoring using the multi-parameter socket does not comply with the Defibrillator proof type BF.**

Left Side Panel

CAUTION

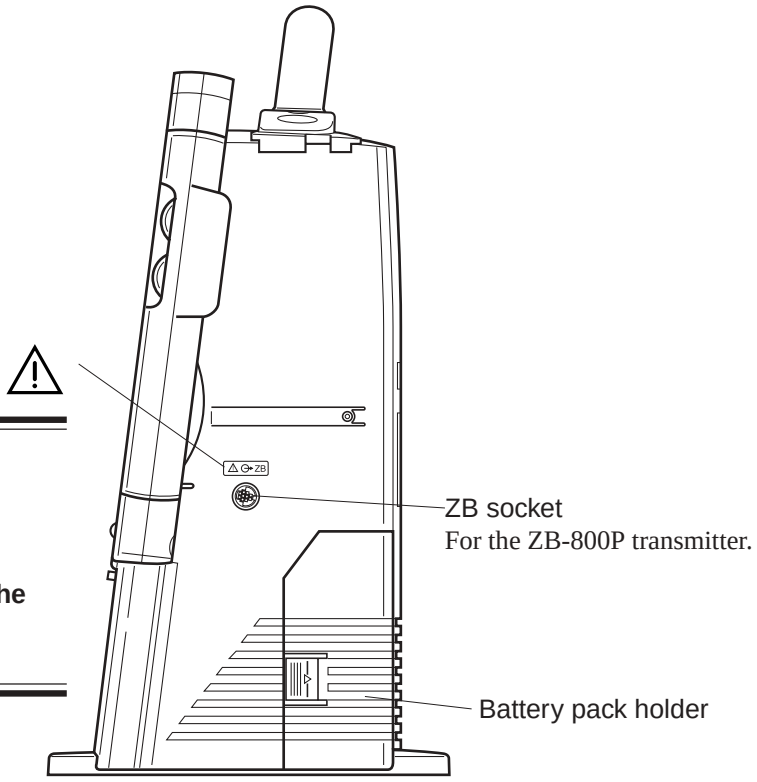
- **Use only the Nihon Kohden card.**
- **Do not press the PC card eject button while the PC card lamp is lit. This may damage the PC card data and interrupt network communication.**


PC card eject button
PC card lamp
Refer to "Connecting the Power Cord and Grounding the Monitor" in Section 2.
PC card slot
For an optional QI-101P network card or a QI-111P network printer card.
Fuse holder
AUX socket
For connecting a display monitor with a YS-072P5 connection cable or an external unit with a YJ-921P connection cable or QI-400P series interface.
AC SOURCE power cord socket
For the AC power cord.
Equipotential grounding terminal
For an equipotential grounding lead.
REMOTE socket
Not available.
AUX
REMOTE

WARNING

Connect only the specified instrument to the socket marked with ⚠ by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.

Right Side Panel



CAUTION

Connect only the ZB-800P transmitter to the ZB socket by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.

The ZB-800P transmitter is 400MHz only.

Basic Operating Concepts

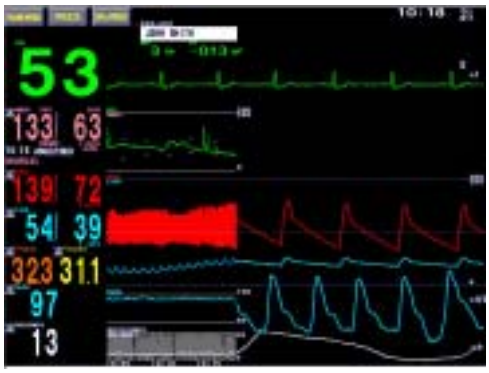
Screen Displays

Following are the screens and windows available on the Life Scope P bedside monitor. For details about the individual screens and windows, see the appropriate section.

The shadow of the previous screen may remain for a few minutes after changing the screen.

Normally, the monitoring screen is displayed. All screens, except for the SYSTEM SETUP screen, return to the monitoring screen when there is no key operation for about 3 minutes.

Monitoring screen



- The monitoring screen can be displayed anytime by pressing the HOME key on the front panel.
- Displays waveforms and data of the monitoring parameters.
- Touching the patient name displays the PATIENT INFO window for changing patient information.
- Touching the parameter data displays the parameter setting window.

MENU window

The MENU window can be displayed anytime by pressing the MENU key on the front panel. From the MENU window, you can display any window except the monitoring screen.

Other windows for monitoring

ENLARGED window for displaying numeric data

ECG SCROLL window for displaying cascaded ECG

12 LEAD window for displaying simultaneous 12 lead ECG. 12 lead ECG interpretation can be performed (BSM-4103/ 4104/4113/4114 monitors only).

Review windows

TREND window for displaying 24 hour trendgraphs of heart rate, EVENT and up to 3 selected parameters at the top and one selected parameter trendgraph at the bottom.

LIST window for displaying list of parameter data.

ARRHYTH RECALL window for displaying arrhythmia recall file data.

HEMO LIST window for displaying hemodynamics data when CO is measured (BSM-4103/4104/ 4113/4114 monitors only).

FULL DISC window for displaying full disclosure. Optional QM-421P flash disk card is required.

ST window for displaying ST level recall waveforms. ST measurement condition can be changed. Optional QM-421P flash disk card is required for displaying recall waveforms.

ALARM HISTORY window for displaying alarm occurrence

Patient information window

PATIENT INFO window for entering patient name and other information. Data can be deleted on this window.

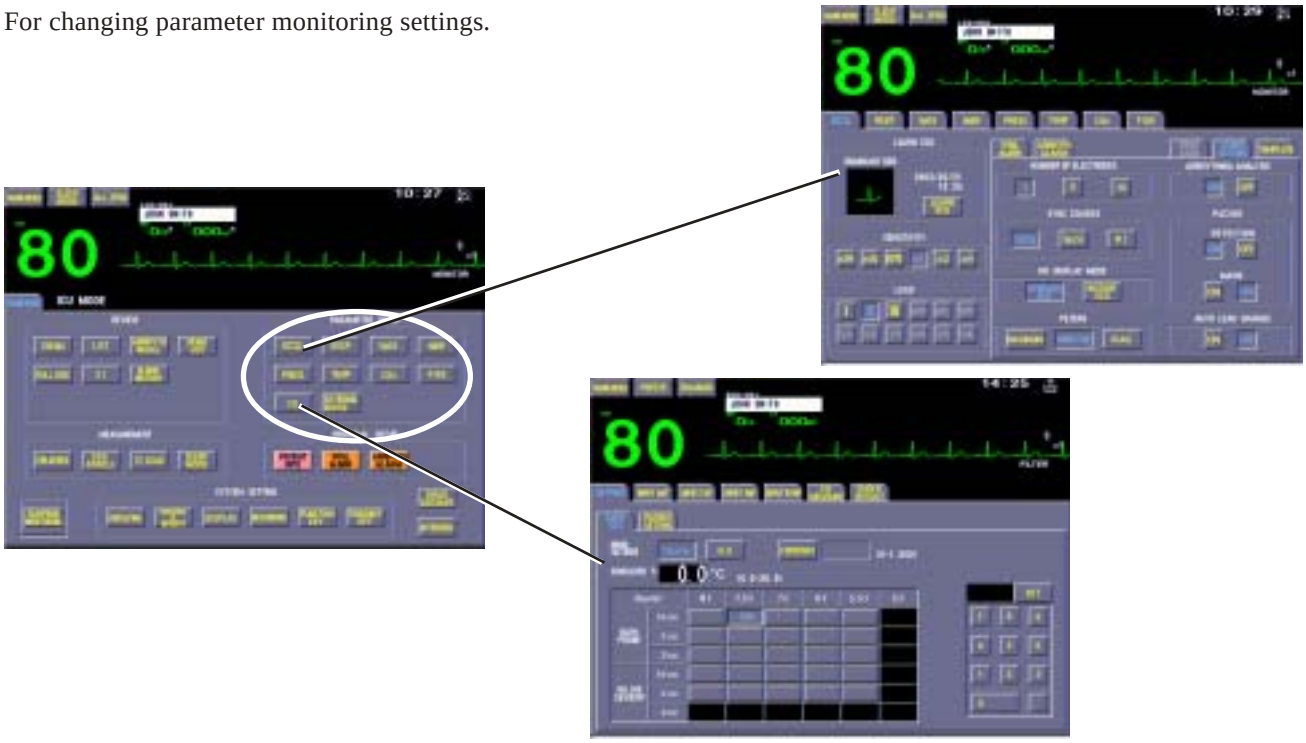
Alarm setting window

VITAL ALARM window for setting vital signs alarm and ARRHYTH ALARM window for setting arrhythmia alarms.

Parameter setting windows

For changing parameter monitoring settings.

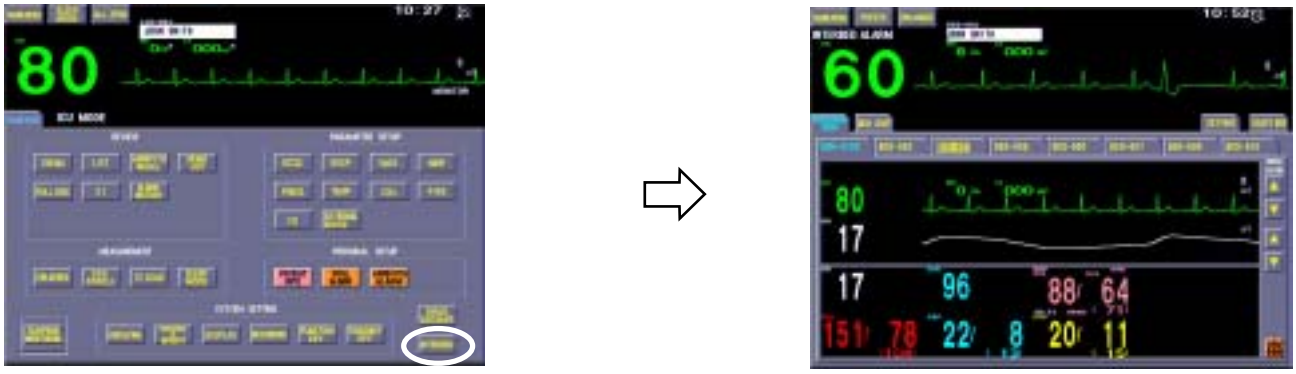
ECG window



CO window

Interbed window

For displaying interbed beds when the monitor is connected to a network.



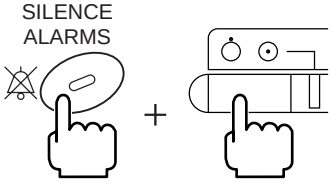
Setup and other windows

DATE&TIME, SOUND & BRIGHT and other windows

RECORDING window for recording setting

DRUG CALCULATE window (BSM-4103/ 4104/4113/4114 monitors only)

SYSTEM SETUP screen



For changing system settings. Displaying the SYSTEM SETUP screen interrupts monitoring.

Using Touch Screen Keys

Any window can be opened and settings can be changed by touching the keys and items on the screen with your finger or the touch pen.

Touching the key on the screen displays the window.

Tabs for changing displaying window. The opened window is displayed in light blue.

Selected item is displayed in light blue

Selectable items or keys are displayed in yellow

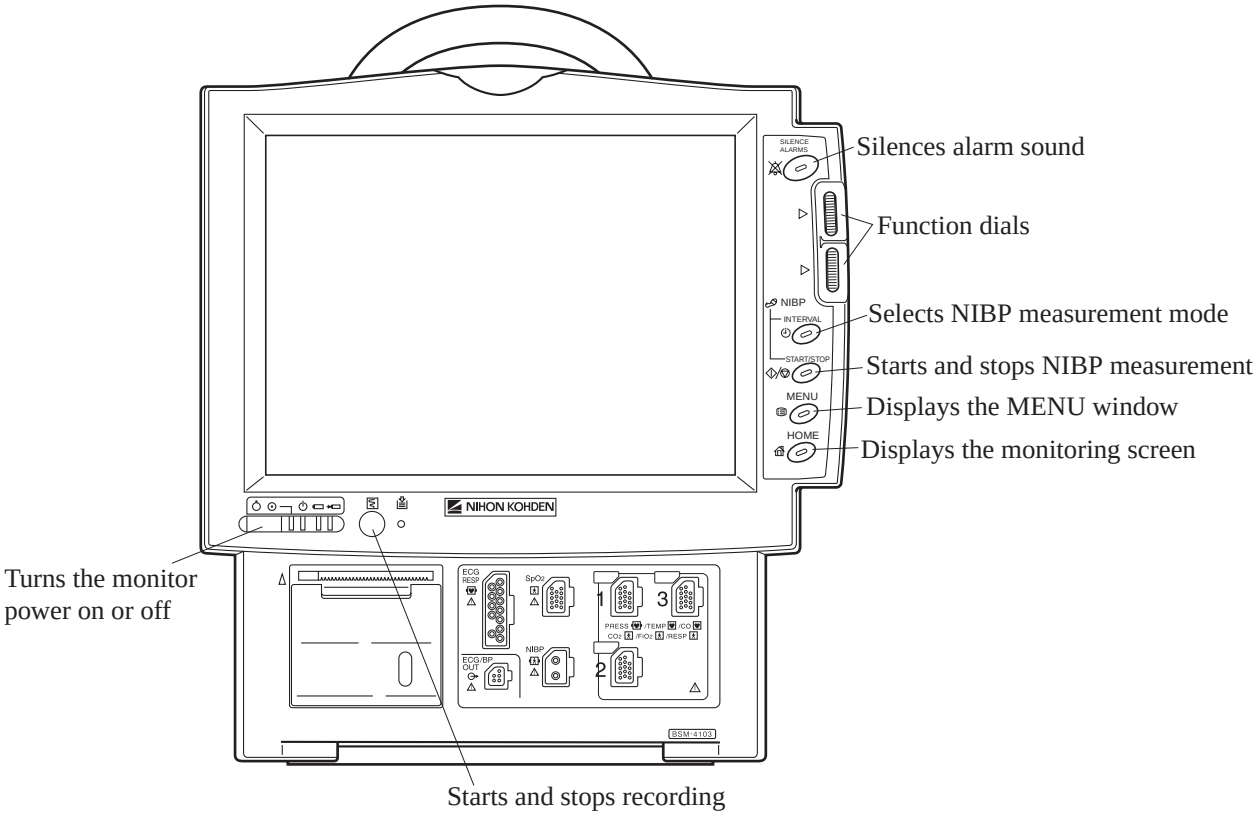
Scroll buttons

Scroll bar and buttons for scrolling data

Cursor
Touch the desired position on the screen to move the cursor

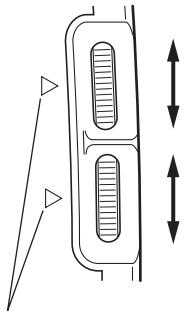
The time width of the trendgraph on the monitoring screen can be adjusted by touching the right edge of the trendgraph and moving it left or right.

Keys on the Front Panel



Using Function Dials

When the function dial lamp is lit, the function dial can be used for changing setting and scrolling data.

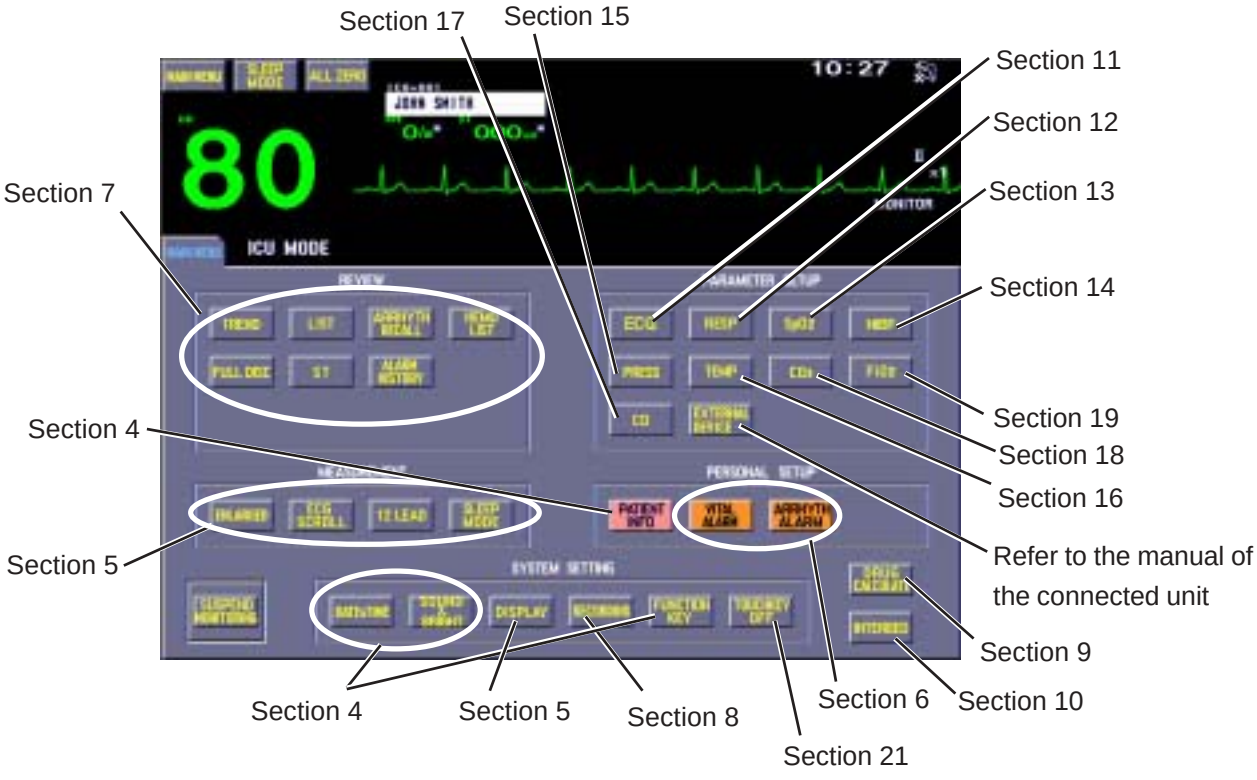


When lit, function dial is available

Using MENU Window

The MENU window can be displayed anytime by pressing the MENU key on the front panel. From the MENU window, you can display any window except the monitoring screen.

For details on each window, refer to the section specified below.



General Safety Information

General

WARNING

- **Never use this monitor in the presence of any flammable anesthetic gas, concentrated oxygen or hyperbaric oxygen. Failure to follow this warning may result in explosion.**
- **Never use the monitor in a high-pressure oxygen medical care tank. Failure to follow this warning may cause explosion or fire.**
- **When using this monitor with an electrosurgery unit, its return plate and the electrodes for monitoring must be firmly attached to the patient. If the return plate is not attached correctly, it may burn the patient's skin where the electrodes are attached. Refer to the instruction manual for the ESU.**
- **When performing MRI tests, remove the electrodes and transducers connected to the patient from this monitor. The heat generated from the induced electromotive force may burn the patient's skin. For details, refer to the instruction manual for the MRI.**
- **When performing defibrillation, discharge as far as possible from electrodes and medicine on the chest of the patient. If there is a possibility that the defibrillator paddle could touch electrodes and medicine, remove electrodes and medicine from the patient. If the defibrillator directly contacts these materials, the discharged energy may cause serious electrical burn to the patient.**
- **Before performing defibrillation, check that the cords and cables of the electrodes and transducers attached to the patient are properly connected to the monitor. Touching the metal parts of disconnected cords and cables may cause serious electrical shock or injury by discharged energy.**
- **To avoid the risk of serious electrical burn, shock or other injury during defibrillation, all persons must keep clear of the bed and must not touch the patient or any equipment connected to the patient.**
- **When using the output signal from the monitor as the synchronization signal for other equipment such as IABP (intra-aortic balloon pump) or defibrillator:**
  - **Set the timing of the other equipment by checking the waveform on the monitoring screen.**
  - **Check the condition of the bedside monitor at all times. The output signal may become unstable.**
  - **Check that the delay time of the output signal (heart rate trigger 64 ms maximum) is within the range of the connected equipment.**
  - **Do not use the heart rate trigger as the synchronization signal for defibrillator.**
- **When performing defibrillation during CO monitoring, never touch the CO connection cord. Otherwise the discharged energy may cause serious electrical burn, shock or other injury.**
- **When performing defibrillation during CO_2 monitoring with the CO_2 sensor kit, remove the sensor from the patient. When the sensor**

cannot be removed, do not touch the sensor cable because the discharged energy may cause serious electrical burn, shock or other injury.

- **During alarm suspension ("REMAINING SUSPEND TIME" message displayed), all current alarms are temporarily turned off.**
- **When EXIT SLEEP MODE ON ALARM on the SYSTEM SETUP screen is set NO, the bedside monitor alarm cannot be seen or heard on the bedside monitor during sleep mode. Monitor the bedside monitor alarm on the central monitor or telemetry system. Otherwise, the bedside monitor alarm may be overlooked.**
- **When admitting a new patient, check the alarm settings. The alarm settings return to the alarm master settings on the SYSTEM SETUP screen when all data is deleted on the DELETE DATA window or 30 minutes elapse after monitor power off.**

CAUTION

- **Use only Nihon Kohden specified electrodes, probes, transducers, thermistors and catheters. Otherwise, the maximum performance from the monitor cannot be guaranteed.**
- **Do not reuse disposable parts.**
- **Turn off the power of cellular telephones, small wireless devices and other devices which produce strong electromagnetic interference. Otherwise, the waveforms and measurements are affected by such interference and the displayed data may be incorrect.**
- **When admitting a new patient, first delete all data of the previous patient. Otherwise, the data of the previous patient and new patient will be mixed together.**
- **After the monitor power is turned on, parameter-related alarms do not function until the parameters are monitored (during standby mode).**
- **Alarm recording is not performed when alarm is suspended or alarm recording is set to off.**
- **If there is any doubt about the arrhythmia analysis, make the monitor relearn the patient's VPC. Otherwise, an important arrhythmia maybe overlooked.**
- **When the upper or lower alarm limit is turned off, there will be no upper or lower alarm for that parameter limit.**
- **When the "CONNECTOR OFF" message appears on the screen, check that the connection cords are connected to the sockets properly. Patient cannot be monitored and the alarm does not function properly while this message is displayed.**
- **Do not turn the monitor off when the system check screen is displayed. Otherwise the saved data may be damaged or deleted. If the monitor is turned off during system check, delete all data because the data is not reliable.**
- **If fluids are accidentally spilled on the monitor, take the bedside monitor out of service and check for damage.**

Installation

WARNING

- **For patient safety, equipotential grounding of all instruments must be performed. Consult with a qualified biomedical engineer.**
- **Connect only the specified instrument to the socket marked with ⚠ by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.**
- **Only use the provided power cord. Using other power cords may result in electrical shock or other injury to the patient and operator.**
- **When the provided power cord cannot be used or when equipotential grounding is doubtful (such as in poor grounding facility), operate the monitor on battery power.**

CAUTION

- **Before connecting instruments, make sure that the power is turned off.**
- **Use only the KC-009P cart for the BSM-4100 series bedside monitor. If another cart is used, it may tip over or the monitor may fall off.**
- **Disconnect the power cord from the AC socket and remove the battery before connecting the instruments.**
- **Install the monitor and ESU appropriately and perform equipotential grounding. Otherwise, noise from the ESU may interfere with the ECG and ECG monitoring may not be performed properly.**
- **After the power on, check that one "bong" sounds and the red and yellow alarm lamps blink once to show that the alarm functions properly.**

Also read the warning and caution in "Selecting a Suitable Location" in Section 2.

Using ZB-800P Transmitter

CAUTION

- **Connect only the ZB-800P transmitter to the ZB socket by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.**
- **Heart rate may differ between the monitor and the telemetry system or central monitor due to the difference on the displaying ECG waveform.**
- **The transmitter can only transmit temperature data from 5 to 45°C (41 to 113°F).**

Network

WARNING

- **Connect the network as specified. Otherwise patient and operator may get electrical shock or other injury. For connecting the network, contact your Nihon Kohden distributor.**
- **Install the printer and hubs outside the patient environment. If they are installed inside the patient environment, the patient or operator may receive electrical shock.**
- **Do not use the damaged network cable. Otherwise patient or operator may get an electrical shock when the damaged part is touched.**
- **Check the software version number of the monitor before connecting it to the network. Different software versions have different communication methods. When there is more than one communication method in the network, communication may malfunction. For details, refer to the Network and System Installation Guide.**

CAUTION

- **The network must be managed by the network administrator. Make sure that each monitor in the network has a different IP address. Otherwise, data communication cannot be performed properly. When adding a unit to an already operating network, set the IP address on the monitor before connecting the monitor to the network.**
- **Use only the Nihon Kohden network card.**
- **Do not push in the network cable with too much force. Otherwise the network card/network printer card or bedside monitor may get damaged.**
- **Do not press the PC card eject button while the PC card lamp is lit. This may damage the PC card data and interrupt network communication.**
- **When the monitor is connected to a central monitor network, set the Bed Name (Bed ID) and Group Name on the monitor. Otherwise, the default settings are used for the bed name and group name and the bed may be incorrectly identified on the central monitor.**

Battery

WARNING

- **Keep the battery pack away from fire.**
- **Keep the battery pack away from children.**
- **Never short-circuit the + and – terminals on the battery pack.**
- **Never disassemble the battery pack.**
- **If the battery pack is damaged and substance inside the battery**

(potassium hydroxide) contacts the skin or clothes, wash immediately and thoroughly with water.

CAUTION

- **Do not subject the battery pack to a strong mechanical shock.**
- **Use the battery pack between 10°C (50°F) and 40°C (104°F). Temperatures out of this range affects the working of the battery.**
- **Do not use a battery which is over the expiration date written on the label.**
- **Before disposing of the battery, check with your local solid waste officials for details in your area for recycling options or proper disposal. The battery is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream.**
- **When charging the battery pack, keep the ambient temperature at approximately 20°C to maintain the optimal battery operation time. If the battery pack is charged at less than 10°C (50°F) or more than 30°C (86°F), the maximum battery operation time will be 20% to 30% less than the optimal operation time.**

12 Lead ECG Interpretation (BSM-4103/4104/4113/4114 monitors only)

CAUTION

- **The 12 lead ECG interpretation is performed for acquired ECG waveforms only and does not reflect all conditions of the patient. The results of the analysis may not correspond to the judgement of a physician.**
- **Overall judgement must be performed by the physician, referring to the analysis result, clinical findings and other examination results. After the physician's overall judgement, the analysis results should be signed or initialed by the physician.**
- **When the patient sex is not specified, the analysis is performed with the patient as male.**
- **When the patient's date of birth or age is not entered, the analysis is performed with the patient as 35 years old.**

ECG Monitoring

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and

Cardiac Monitoring and Diagnostic Equipment*
The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. If this occurs, disconnect the monitor or diagnostic equipment from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden distributor.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the patient, resulting in an elevated pacing rate.

  For more information, see the FDA web site.
  http://www.fda.gov/cdrh/safety.html

WARNING

- **When using a defibrillator together with the monitor, use Ag/AgCl electrodes. Other types of electrodes, stainless steel in particular, will adversely affect the ECG waveform by slowing the baseline recovery on the monitor and result in no monitoring immediately following defibrillation.**
- **False heart rate indicators may occur with certain pacemakers because of electrical overshoots.**
- **Pacemaker patients can only be monitored when the pace program is activated.**
- **Keep pacemaker patients under close observation. The pacemaker rate may be counted during cardiac arrest and certain arrhythmias. Do not rely only on the monitor.**
- **For arrhythmia monitoring, set ARRHYTHMIA ANALYSIS on the ECG window to ON. Otherwise, there is no sound or indication for arrhythmia alarms.**

CAUTION

- **Use only Nihon Kohden products and specified parts and accessories. When other type of electrodes are used, the "CHECK ELECTRODES" message may be displayed and monitoring may stop.**
- **Do not reuse disposable electrodes.**

- **If the contact is bad even before the expiration date printed on the package, replace the electrode with a new one.**
- **When the "CHECK ELECTRODE" message is displayed, ECG is not monitored properly. Check the electrode and if necessary, replace it with a new one.**
- **When using the monitor with an ESU, locate the monitor and ESU following the description in "Use with an Electrosurgical Unit" in Section 11 and ground the instruments properly. Otherwise noise from the ESU may interfere with the ECG and the heart rate and arrhythmia analysis may be incorrect.**
- **At the start of ECG monitoring, check that the dominant QRS is appropriate. Otherwise arrhythmia monitoring may be inaccurate.**
- **If there is any doubt about the arrhythmia analysis, make the monitor relearn the patient's VPC and check that the dominant QRS is appropriate. Otherwise, arrhythmia monitoring may not be accurate.**
- **Turn the pacing spike detection to on when monitoring a pacemaker patient. Otherwise QRS and pacemaker spike may not be distinguished and pacemaker failure may not be recognized.**
- **QRS of a waveform which has been expanded after being compressed may be distorted. When reading the expanded ECG waveforms, be aware of this distortion.**
- **When the alarm is turned OFF for an arrhythmia, there will be no alarm for that arrhythmia type. There is no message or mark to indicate that a certain arrhythmia alarm is turned off, therefore, take care when turning off an arrhythmia alarm.**

Respiration Monitoring

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment*

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. If this occurs, disconnect the monitor or diagnostic equipment from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden distributor.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the

patient, resulting in an elevated pacing rate.

For more information, see the FDA web site.
http://www.fda.gov/cdrh/safety.html

SpO_2 Monitoring

WARNING

- **Measurement may be incorrect in the following cases.**
  - **When the patient's carboxyhemoglobin or methemoglobin increases abnormally.**
  - **When dye is injected in the blood.**
  - **When using an electrical surgery unit.**
  - **During CPR.**
  - **When there is body movement.**
  - **When there is vibration.**
  - **When measuring at a site with venous pulse.**
  - **When the pulse wave is small (insufficient peripheral circulation).**
  - **When using an IABP (intra-aortic balloon pump).**
- **Check the circulation condition by observing the skin color of the measuring site and pulse waveform. Change the measuring site every 8 hours for disposable probes and every 4 hours for reusable probes. The skin temperature may increase at the attached site by 2 or 3°C (4 or 5°F) and cause a burn or pressure necrosis. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.**
  - **A patient with a fever**
  - **A patient with peripheral circulation insufficiency**
  - **Neonate or low birth weight infant with delicate skin**
- **To avoid poor circulation, do not wrap the tape too tight. Check the blood circulation condition by observing the skin color and congestion at the skin peripheral to the probe attachment site. Even for short-term monitoring, there may be burn or pressure necrosis from poor blood circulation, especially on neonates or low birth weight infants whose skin is delicate. Accurate measurement cannot be performed on a site with poor peripheral circulation.**
- **When not monitoring SpO_2, disconnect the SpO_2 connection cord from the bedside monitor. Otherwise, noise may interfere from the probe sensor and displays incorrect data on the screen.**
- **Do not use the probe during MRI examination because it may cause skinburn on the probe attachment area. For details, follow the MRI operator's manual.**

CAUTION

- **When using Nellcor probes, read the instructions provided with the probe.**
- **When using Nellcor probes on the BSM-4102/4104/4112/4114 monitors, do not touch the SpO_2 socket pins on the monitor with your finger when connecting or disconnecting the connection cord from the monitor. The monitor may malfunction or get damaged.**
- **Turn off the power of cell telephones, small wireless devices and other devices which produce strong electromagnetic interference. Otherwise, the waveforms and measurements are affected by such interference and the displayed data may be incorrect.**
- **Only use the specified probes. Otherwise SpO_2 cannot be monitored properly.**
- **Do not use a damaged or disassembled probe. It causes incorrect measurement and may hurt the patient.**
- **Do not use the probe over its stated lifetime. Otherwise the SpO_2 measurement accuracy cannot be guaranteed.**
- **If the skin gets irritated or redness appears on the skin from the probe, change the attachment site or stop using the probe.**
- **Do not attach the probe to the same limb that is used for NIBP measurement or an IBP catheter.**
- **Normally external light does not affect monitoring, however, strong light such as an operating lamp or sunlight may affect monitoring. If affected, cover the measuring site with a blanket.**
- **When attached, make sure that the light emitter and the photo detector of the probe face each other. Otherwise, SpO_2 cannot be measured properly.**
- **Do not reuse the disposable probes for another patient because it causes cross infection.**
- **Disposable probes are not sterilized. To sterilize the probe, refer to the "Sterilizing the Disposable Probe" in Section 21.**
- **When the probe is attached on an appropriate site with sufficient circulation and the error message confirming the probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.**
- **When the probe or SpO_2 connection cord failure message appears on the screen, replace it with a new one. Otherwise SpO_2 data may not be accurate.**
- **If the attachment site is dirty with blood, clean the attachment site before attaching the probe. If there is nail polish on the attachment site, remove the polish. Otherwise, the amount of transmitted light decreases, and measured value may be incorrect or measurement cannot be performed.**
- **To minimize body movement for stable SpO_2 monitoring, fasten the cable with the provided adhesive tape.**
- **Do not pull or bend the probe cable, and do not put caster feet on the probe cable. Do not immerse the probe cable in detergents or water. Failure to follow these cautions may cause cable discontinuity, short circuit, skin burn on the patient and incorrect measurement data.**

Replace any broken probe with a new one.

- **Be careful when removing the probe or foam tape from neonatal skin.**
- **When removing a probe that is taped to the skin, do not pull the cable part of the probe because this can damage the probe's cable connection.**
- **Do not immerse the probe in detergents or water. If the probe adhesive surface gets wet, adhesiveness becomes weak and the probe cannot be attached to the skin.**
- **While a patient is on medication which causes vasodilation, the pulse waveform may change and in rare cases the SpO_2 value may not be displayed.**
- **Refer to the probe instruction manual for details.**

NIBP Monitoring

WARNING

- **NIBP measurement on a sickle cell anemia patient may cause a thrombus.**
- **When attaching the cuff to a premature infant at an early stage after birth, periodically change the cuff position to avoid possible skin erosion and fissure.**
- **While performing continuous measurements many times without a pause, periodically check the blood vessels and limb for adequate circulation.**
- **When performing long term measurements at intervals less than 2.5 minutes, periodically check the state of the patient, blood vessels and limb for adequate circulation.**
- **When too much pressure is applied to the cuff, or the hose is folded, the "NIBP SAFETY CIRCUIT RUNNING" message appears on the screen and NIBP monitoring may be stopped. Remove the cause, wait for 40 seconds, check that the message disappears, then measure again.**

CAUTION

- **Only use the specified cuff. Otherwise NIBP monitoring cannot be performed properly or the monitor may be damaged.**
- **Select the cuff which fits each patient. If the cuff size is not correct, measurement may not be completed or the result may be erroneous due to the different deflation speed of the cuff.**
- **The YP-950T/951T/952T/953T/954T/955T reusable cuffs contain natural rubber latex which may cause allergic reactions.**
- **Do not reuse the disposable cuff.**
- **Disposable cuffs are not sterilized. If necessary, sterilize the cuff using glutaraldehyde solution.**

- **The non-sterilized disposable cuffs for neonates cannot be sterilized. If necessary, use the sterilized disposable cuffs for neonates.**
- **Never sterilize the disposable cuff for neonates.**
- **Do not wrap the cuff on an arm or thigh which is used for injection. NIBP measurement on an arm or thigh which is used for injection may cause reflux of blood and stop injection.**
- **Confirm that the air hoses are firmly connected between the sockets and hoses of the cuff. If not connected properly (the air hose connector clicks when properly inserted into the socket), the cuff cannot be correctly identified and air leakage will cause incorrect NIBP data or no data.**
- **If the hose is folded or squeezed, it will cause incorrect NIBP data due to the air pressure noise.**
- **Do not rely only on the PWTT* to monitor blood pressure changes. When it is necessary to monitor critical blood pressure change, set the appropriate interval for NIBP measurement.**
- **When the delta PWTT* threshold is too short for a patient, NIBP measurement may be performed too frequently. If this occurs, change the delta PWTT* threshold to a longer time.**
- **The PWTT* may be incorrect when there is too much arrhythmia or noise.**
- **In the following cases, PWTT* may trigger too many or no NIBP measurements. Check the patient condition. If necessary, change the delta PWTT* threshold or set the PWTT* to Off.**
  - **Rapid blood pressure change with vasoreflex due to vasoactive drugs, such as phenylephrine and nicardipine.**
  - **Unstable pulse wave due to poor peripheral circulation.**
  - **Too many arrhythmias.**
  - **Patient movement.**
  - **Noise on ECG due to ESU.**
  - **SpO_2 measurement on foot of a child.**
- **Do not measure NIBP with PWTT* on a neonate because circulation of a neonate changes rapidly.**

* PWTT is only available for the BSM-4101/4103/4111/4113 monitors.

IBP Monitoring

WARNING

- **All parts, except for transducers, must be non conductive. Otherwise, the discharged energy may cause electrical shock to the operator during defibrillation.**
- **Do not use an expired saline pack.**
- **Do not use a blood pressure monitoring kit from a torn package.**
- **Vent out any air inside the saline pack by squeezing the saline pack. Otherwise, the air will cause an error in the blood pressure data and can enter the patient's blood vessel.**

CAUTION

- **Turn off the power of cell telephones and small wireless devices, or other devices which produce strong electromagnetic interference. Otherwise, the waveforms and measurements are affected by such interference and the displayed data may be incorrect.**
- **Check that there are no scratches on the catheter balloon before use.**
- **Do not reuse disposable parts and accessories.**
- **Do not leave bubbles in the flushed dome and extension tube because they will distort the blood pressure waveform.**
- **Carefully flush the tube joints because bubbles tend to remain in the joints.**
- **Do not pressurize the pressure bag until bubbles are removed from both the dome and the extension tubes.**

Temperature Monitoring

CAUTION

- **Select the appropriate probe for the patient. Using adult probes on premature infants and children may injure the mucous membrane.**
- **Do not reuse disposable probes on other patients.**
- **The insulation pad may irritate the skin. In long term monitoring, change the attachment site.**

CO Monitoring

WARNING

When performing defibrillation during CO monitoring, never touch the CO connection cord. Otherwise the discharged energy may cause serious electrical burn, shock or other injury.

CAUTION

- **Check that there are no scratches on the catheter balloon before use.**
- **Do not reuse disposable products.**
- **Insert or extract the catheter from the pulmonary artery as quickly as possible. If it takes a long time (about longer than 10 seconds), pulmonary infarction, pulmonary hemorrhage or pulmonary artery perforation may occur.**
- **Insert or extract the catheter by referring to the blood pressure waveform on the monitor, X-ray unit images, and other equipment. Do**

not depend on the insertion or extraction messages displayed on the monitor.

- **Do not measure the cardiac output repeatedly at short intervals. Frequently injecting the injectate affects the measuring accuracy.**

CO_2 Monitoring

WARNING

- **When performing defibrillation during CO_2 monitoring with the CO_2 sensor kit, remove the sensor from the patient. When the sensor cannot be removed, do not touch the sensor cable because the discharged energy may cause serious electrical burn, shock or other injury.**
- **Do not use the airway adapter on neonates because the dead space volume of the airway adapter is about 5 cc.**
- **When using the airway adapter on children or patients with low ventilatory amount, the CO_2 may mix in the inspiration due to the airway adapter's dead space volume (5 cc), resulting in inaccurate measured values or difficulty in detecting apnea.**
- **Before MRI examination, remove the CO_2 sensor kit from the patient. Failure to follow this warning may cause serious electrical burn on the patient due to local heating caused by dielectric electromotive force. For details, refer to the MRI operator's manual.**
- **With the TG-900P CO_2 sensor kit, this monitor cannot monitor CO_2 of patients younger than 3 years old or weighing less than 10 kg (22 lbs).**

CAUTION

- **When monitoring CO_2 of a patient under anesthesia, make sure that the gas composition is entered. Otherwise the measurement result may be inaccurate.**
- **When using an anesthetic instrument with volatile anesthetic agent, the CO_2 measurement may become inaccurate.**
- **With the TG-900P CO_2 sensor kit, measurements are based on the assumption of no CO_2 gas in the inspiration. The CO_2 concentration in the respiration is calculated by taking the CO_2 concentration in the inspiration as 0 mmHg. Therefore, measuring CO_2 by connecting the CO_2 sensor kit to a Jackson Rees circuit or Mapleson D circuit where CO_2 gas may be present during inspiration may result in the acquired data being lower than the actual value.**
- **With the TG-950P CO_2 sensor kit, measured value may be incorrect when the operating temperature changes greatly. In this case, wait for about 30 minutes to acquire stable measurement.**
- **Turn off the power of cellular telephones, small wireless devices and other devices which produce strong electromagnetic interference.**

Otherwise, the waveforms and measurements are affected by such interference and the displayed data may be incorrect.

- **The measurement may be inaccurate when electromagnetic noise from another instrument interferes with the CO_2 waveform.**
- **We recommend using another method or using a shielded room for monitoring CO_2 when respiration monitoring is important.**
- **The airway adapter is non-sterilized and disposable. Use only for single patient and single use. Failure to follow this instruction causes cross infection.**
- **Do not sterilize the airway adapter more than once. The safety cannot be guaranteed.**
- **Use the Nihon Kohden specified airway adapter.**
- **Secure the CO_2 sensor cable to the respiration circuit so that it is parallel to the floor. If the cable is perpendicular to the floor, water droplets may get onto the transparent film of the airway adapter, and affect the measurement accuracy.**
- **When the "CHANGE ADAPTER" or "CHECK SENSOR" message is displayed, check the CO_2 sensor kit and replace with a new one when necessary. CO_2 cannot be monitored while the message is displayed.**
- **The transparent film of the airway adapter is coated with the anti-fogging material to prevent the moisture of the expiration and inspiration from making the inside of the airway adapter foggy. Under the operating environment specified in the specifications, the anti-fogging material works for about 24 hours. For the optimum performance of the anti-fogging material and correct measurement, follow the instructions below.**
  - **Do not use the airway adapter more than 24 hours.**
  - **Replace the airway adapter if blood, sputum or mucus adheres to the transparent film of the airway adapter.**
  - **Do not damage the transparent film, and do not let dust or chemical solutions contact the transparent film. Do not touch the transparent film with your fingers, do not wipe it, and do not wash it with alcohol or other detergents.**
- **Replace the airway adapter with a new one every 24 hours. Using the airway adapter for longer than 24 hours affects measurement accuracy.**
- **Obey the CAUTION label on the CO_2 gas cylinder.**
- **After the lifetime of the CO_2 gas cylinder expires, the measurement accuracy cannot be guaranteed.**

FiO_2 Monitoring

CAUTION

The oxygen sensor must be stored with the detector facing down because the detector gets dried and FiO_2 monitoring cannot be performed properly. If the detector is dry, the oxygen sensor must be left with the detector facing down for 1 or 2 minutes or, when the filter is completely dry, more than 12 hours.

Maintenance

CAUTION

- **Do not disassemble the monitor. Disassembly must be performed by a qualified service personnel.**
- **Fuses must be replaced by a qualified service personnel.**
- **Do not use volatile liquids such as thinner or benzine, because these will cause the materials to melt or crack.**
- **Before cleaning the monitor, turn the monitor power off and disconnect the power cord from the AC SOURCE power cord socket on the left side panel.**
- **After cleaning, make sure that the monitor is completely dried.**
- **Wipe the monitor thoroughly after disinfecting it with spray.**
- **The bedside monitor is not waterproof. Be careful not to let any water get inside the monitor.**
- **Never sterilize the monitor because the materials may deform, crack or discolor.**

Section 2 Preparations

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Preparation Flowchart

You may not need to do all these.

1. Install the monitor and do the procedures in Section 2.

2. Check or change any initial settings on the SYSTEM SETUP screen. These items usually do not need to be changed. Refer to Section 3.

3. Check or change the necessary settings before monitoring in Section 4.
   - Date and time
   - Sound volume
   - Screen brightness
   - Assign function to the function keys

4. Enter the information of the new patient. Refer to “Entering Patient Information” in Section 4.

5. Check or change all alarm items for the patient. Alarm settings return to the default settings 30 minutes after the monitor is turned off. Refer to Section 6.

6. Check or change settings for the vital signs list, trendgraphs and arrhythmia recall files. Refer to Section 7.

7. Check or change recording settings. Refer to Section 8.

8. Prepare the equipment (electrodes, transducers, probes, etc.) for monitoring individual parameters and check or change the settings for each parameter. Refer to Sections 11 to 19.

WARNING

When admitting a new patient, check the alarm settings. The alarm settings return to the alarm master settings on the SYSTEM SETUP screen when all data is deleted on the DELETE DATA window or 30 minutes elapse after monitor power off.

Installation Conditions

Put the monitor on a stable and flat stand or on an optional KC-009P cart in a suitable location where the screen is easy to see and does not reflect light. Follow the cautions below.

For installing the monitor on the KC-009P cart, refer to the KC-009P cart installation guide.

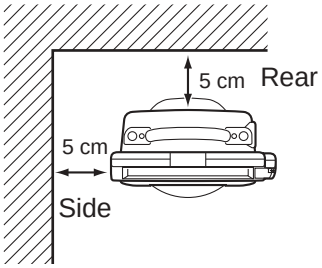
WARNING

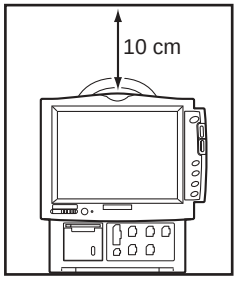
- **Never use this monitor in the presence of any flammable anesthetic gas, concentrated oxygen or hyperbaric oxygen. Failure to follow this warning may result in explosion.**
- **Connect only the specified instruments to the connector or sockets marked with ⚠ by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.**

CAUTION

- **Avoid collision when moving the monitor on a cart. Strong impact may damage the monitor.**
- **The display screen is made of glass. Strong impact may damage it.**
- **Avoid a location where the monitor is sprinkled with liquids. Avoid direct sprinkling, spray or moist air from a nebulizer or a humidifier.**
- **If fluids are accidentally spilled on the monitor, take the monitor out of service and check for damage.**
- **Avoid locations where the monitor may receive strong electromagnetic interference such as radio or TV stations, cellular phones or mobile two-way radios.**
- **Do not use the monitor in an ambulance. The monitor may not function properly in a moving vehicle.**
- **Avoid exposing the monitor to direct sunlight.**
- **Do not place the monitor in a dusty area.**
- **Do not place blankets or cloth over the monitor. It may affect monitoring.**
- **Connect the power cord to an AC outlet which can supply enough AC current to the monitor. The monitor cannot function properly with low current.**
- **Do not place the monitor in an MRI examination room. The monitor may not function properly, or noise from the monitor may interfere with the MRI.**
- **Do not use an electrical blanket. It may affect monitoring.**

- **Make sure that there is more than 5 cm of space between the monitor and the wall for adequate ventilation. When the monitor is surrounded, make sure that there is about 10 cm of space above the monitor for ventilation so that the operating temperature does not exceed 40°C (104°F).**





Avoid placing the monitor near a heater or humidifier.

- **When there is any problem on the monitor, turn off the power immediately and disconnect the power cord from the AC outlet. Take the monitor out of service and check for damage.**

Loading the Recording Paper

Recorder is built into the BSM-4101/4102/4103/4104 bedside monitors.

CAUTION for Handling the Recording Paper

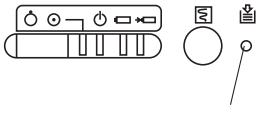
- **Do not allow paper to contact pastes, adhesive agents, oil-based felt pen tips or diazo process (ditto/spirit) copying paper. These discolor the paper surface.**
- **Do not allow paper to contact any materials made of vinyl chloride, plastic eraser, adhesive tape, fluorescent felt tip pen, or cinnabar seal ink because these discolor the recorded waveforms and data.**
- **Do not apply strong pressure to the paper. Rubbing or scratching discolors the paper surface.**
- **Do not allow paper to contact saline solution. The paper discolors and if the saline solution gets on the thermal head, there will be dots missing from the recorded data.**
- **Avoid high humidity, high temperature, direct sunlight and direct fluorescent light when storing recording paper. Otherwise the paper may discolor. Store the recording paper in a dry, cool place.**
- **When using glue on the recording paper, use glue which consists of starch, polyvinyl alcohol, gum arabic, or carboxymethyl.**

CAUTION for Loading the Recording Paper

- **Correctly load the recording paper as specified. Otherwise, recording may not be performed properly.**
- **Do not touch the recording head with any hard material. When the head is tapped with hard material, the head may crack and the heater element wire may short-circuit.**
- **Clean the head surface with the provided head cleaner pen before loading new paper. After a period of usage, paper dust may accumulate between the paper and the head surface, and good printing cannot be obtained.**

NOTE

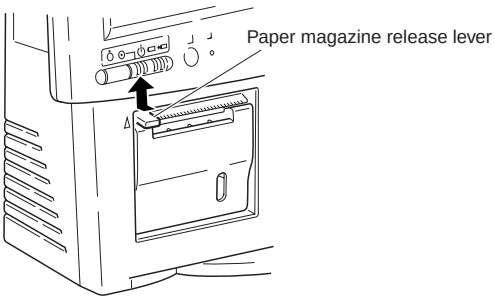
Only use the specified recording paper, FQW50-3-100.

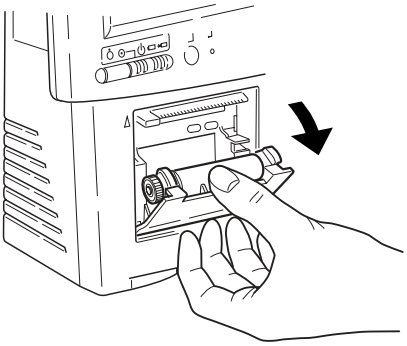


Out of paper lamp

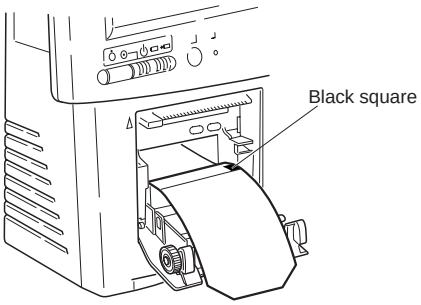
The out of paper lamp on the front panel lights and the out of paper mark appears on the screen when there is no paper.

1. Move the paper magazine release lever in the direction of the arrow (△) to release the lock.

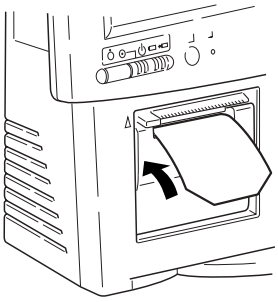




2. Open the paper magazine.



3. Set the recording paper (FQW50-3-100) inside the magazine so that the detection mark (small black square on corner) of the paper is on the right side.



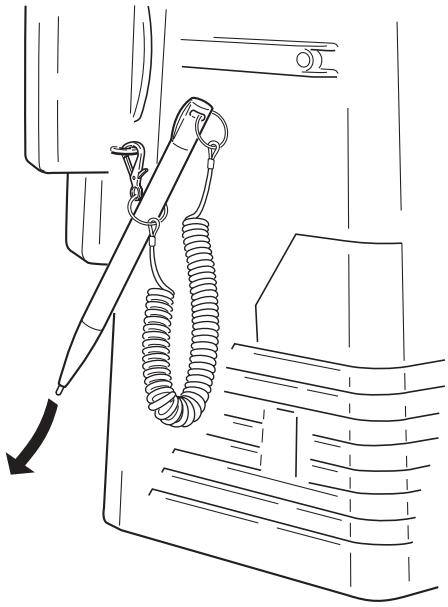
4. Draw out one page of paper toward you and close the paper magazine.

   If the out of paper lamp is still lit, the magazine is not closed properly.

Attaching the Touch Pen

Hook the spring catch of the touch pen string to the hook on the rear of the key panel.

When not using the touch pen, put it through the ring on the touch pen string as shown below.

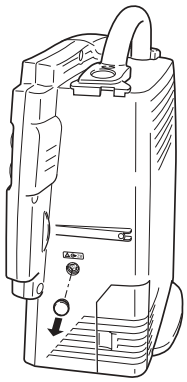


Connecting the Optional ZB-800P Transmitter

The ZB-800P transmitter transmits data from the monitor to a Cardiac Telemetry System or Central Monitor. A Multiple Patient Receiver is necessary with the central monitors. The ZB-800P transmitter is 400MHz only.

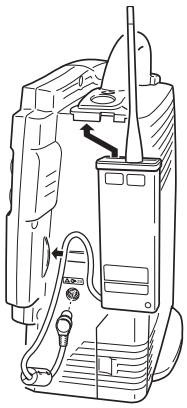
CAUTION

- **Heart rate may differ between the monitor and the telemetry system or central monitor due to the difference on the displaying ECG waveform.**
- **The transmitter can only transmit temperature data from 5 to 45°C (41 to 113°F).**



1. Turn the monitor power off.

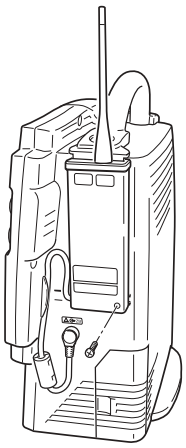
2. Remove the cover from the ZB socket on the right panel.



3. Insert the transmitter into the slit at the top on the right side panel.

4. Connect the transmitter cable to the ZB socket on the right side panel.

5. Run the transmitter cable along the cable guide on the right side panel.



6. Fasten the transmitter to the monitor with the screw.

Connecting an External Instrument to the Monitor

An external instrument, such as a display monitor, can be connected to the AUX socket on the left side panel. For details, contact your Nihon Kohden distributor.

Using the optional QI-400P series interface, the following instrument can be connected to the monitor.

- QI-401P: Display monitor, AG-920R multigas unit, AG-400R CO_2 unit, AP-400R non-invasive blood pressure unit, etc
- QI-402P: Aspect BIS monitor
- QI-403P: Drager ventilator
- QI-404P: Servo300 ventilator
- QI-405P: Oridion Microcap
- QI-406P Puritan Bennett ventilator
- QI-408P Servo i ventilator

The QI-401P interface can be mounted on the KC-009P cart. To connect the interface to the monitor, refer to the interface operator's manual.

WARNING

For patient safety, equipotential grounding of all instruments must be performed. Consult with a qualified biomedical engineer.

When more than one electrical instrument is used, there may be electrical potential difference between the instruments. Potential difference between instruments may cause current to flow to the patient connected to the instruments, resulting in electrical shock (micro shock). Never use any medical equipment in patient treatment without proper grounding.

Always perform equipotential grounding as specified in IEC60601-1-1 when required. It is often required in the operating room, ICU room, CCU room, cardiac catheterization room and X-ray room. Consult with a biomedical engineer to determine if it is required.

Refer to the reference "General Requirements for Connecting Medical Electrical System" in Section 22.

WARNING

Connect only the specified instruments to the connector or sockets marked with ⚠ by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.

CAUTION

Disconnect the power cord from the AC SOURCE socket before connecting the instruments.

Connecting the Monitor to a Network

Either a QI-101P network card or a QI-111P network printer card can be inserted into the bedside monitor. These two cards cannot be used at the same time.

The optional QI-101P network card allows connection to a central monitor network*. Bedside monitor data can be sent to the central monitor. When the monitor has no recorder, waveforms and data can be recorded manually on the central monitor recorder from the bedside monitor.

The optional QI-111P network printer card allows connection to a bedside monitor network with no central monitor*. Monitor data can be printed on a printer connected to the network. The review window data, 12 lead ECG interpretation (BSM-4103/4104/4113/4114 monitors only) and manual printing can be performed.

* For details about the central monitor network and bedside monitor network, refer to the Network and System Installation Guide.

WARNING

For patient safety, equipotential grounding of all instruments must be performed. Consult with a qualified biomedical engineer.

When more than one electrical instrument is used, there may be electrical potential difference between the instruments. Potential difference between instruments may cause current to flow to the patient connected to the instruments, resulting in electrical shock (micro shock). Never use any medical equipment in patient treatment without proper grounding.

Always perform equipotential grounding as specified in IEC60601-1-1 when required. It is often required in the operating room, ICU room, CCU room, cardiac catheterization room and X-ray room. Consult with a biomedical engineer to determine if it is required.

Refer to the reference “General Requirements for Connecting Medical Electrical System” in Section 22.

WARNING

- **Check the software version number of the monitor before connecting it to the network. Different software versions have different communication methods. When there is more than one communication method in the network, communication may malfunction. For details, refer to the Network and System Installation Guide.**

- **Connect only the specified instruments to the connector or sockets marked with ⚠ by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.**

CAUTION

Before connecting instruments, make sure that the power is turned off.

NOTE

The time on this monitor is automatically adjusted to match the time of the network as long as the monitor is connected to the network. The date and time on all monitors in the network are set to the same setting.

Installing the Optional Network Card or Network Printer Card

The network card or network printer card can be installed while the monitor power is on.

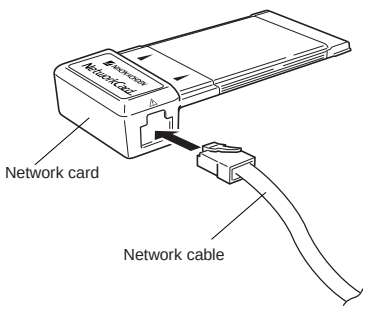
For details on handling the network card/network printer card, refer to the QI-101P network card or QI-111P network printer card operator's manual.

WARNING

- **Connect the network as specified. Otherwise patient and operator may get electrical shock or other injury. For connecting the network, contact your Nihon Kohden distributor.**
- **Do not use the damaged network cable. Otherwise patient or operator may get an electrical shock when the damaged part is touched.**

NOTE

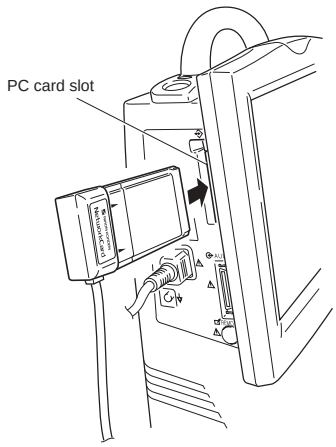
- **Use only the shielded network cable with the resin plug for the HUB connector.**
- **Use only a hub which complies with IEC60950 or UL1950.**



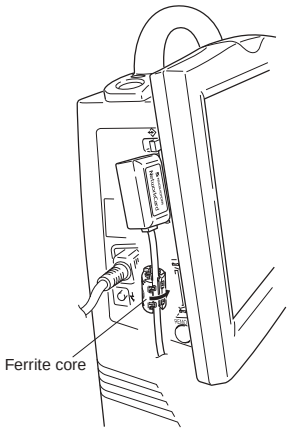
1. Connect the network cable to the socket on the network card/network printer card. Insert the cable connector until it clicks.

CAUTION

Do not push in the network cable with too much force. Otherwise the network card/network printer card or bedside monitor may get damaged.



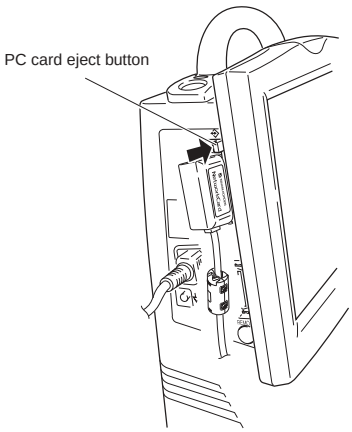
2. Insert the network card/network printer card with the metal side facing front into the PC card slot on the left side panel.



3. Attach the ferrite core to the network cable.

NOTE

A ferrite core must be attached to every network cable.



When removing the network card/network printer card from the monitor, press the PC card eject button.

NOTE

The network card/network printer card may get hot after long term use, but this does not mean that the card is damaged.

Power

AC or Battery Power Source Selection

The monitor can operate on either battery or AC power.

When the power cord is plugged into an AC outlet and the power switch on the front panel is turned on, the monitor operates on AC power.

When a battery is inserted and the power cord is disconnected, such as when transferring a patient, the monitor automatically switches to battery power.

The battery is charged when the power cord is plugged into an AC outlet and the AC current is supplied to the monitor. The battery is also charged during monitoring.

When the monitor is operated on battery power, the brightness of the screen can be reduced to save battery power. Refer to Section 3.

The monitor can operate for about 1 hour with a fully charged battery pack when:
- Used in normal temperature
- Recorder is not used
- No alarm occurs
- No NIBP measurement
- POWER SAVE MODE on the SYSTEM SETUP screen is set to ON.

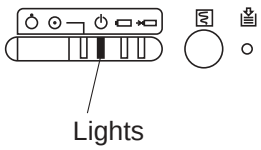
Connecting the Power Cord and Grounding the Monitor

Connecting the Power Cord

WARNING

- **Only use the provided power cord. Using other power cords may result in electrical shock or other injury to the patient and operator.**
- **When the provided power cord cannot be used, operate the monitor on battery power.**

Connect the provided power cord to the AC SOURCE socket on the side panel of the monitor and plug the cord into a 3-prong AC outlet.



When the AC power is supplied to the monitor, the AC power lamp on the front panel lights and a buzzer sounds.

NOTE

If the AC power lamp does not light or there is no buzzer sound, check the power cord connection.

Grounding the Monitor

WARNING

- **For patient safety, equipotential grounding of all instruments must be performed. Consult with a qualified biomedical engineer.**
- **When equipotential grounding is doubtful (such as in poor grounding facility), operate the monitor on battery power.**

When more than one electrical instrument is used, there may be electrical potential difference between the instruments. The potential difference between the instruments may cause current to flow to the patient connected to the instruments, resulting in electrical shock (micro shock).

Always perform equipotential grounding when required. It is often required in the operating room, ICU room, CCU room, cardiac catheterization room and X-ray room. Consult with a biomedical engineer to determine if it is required.

When equipotential grounding is required, connect the equipotential ground terminal on the instrument to the equipotential ground terminal on the wall (equipotential grounding system) with the equipotential grounding lead (potential equalization conductor).

Turning the Power On

Check Before Turning On the Power

Check the following items before turning on the power.

- Enough electrodes and electrode leads are ready.
- Cleaned and sterilized sensors and transducers are ready.
- Power cord is connected properly.
- Equipotential grounding lead is connected properly when equipotential grounding is required.
- All cables are connected properly.
- Enough recording paper in the recorder (for BSM-4101/4102/4103/4104 monitors).
- Batteries are fully charged when operating on battery power.
- No scratches, damage or dirt on the monitor.
- No damage to the keys, dials and panels.
- No damage to the power cord.
- No damage to the electrode leads, transducers, probes and cables.
- The monitor is not in a wet place.
- The handle is not damaged.

Turning the Power On

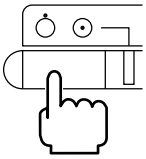
CAUTION

Do not turn the monitor off when the system check screen is displayed. Otherwise the saved data may be damaged or deleted. If the monitor is turned off during system check, delete all data because the data is not reliable.

NOTE

- **It takes a few minutes for the LCD screen to reach full brightness.**
- **The shadow of the previous screen may remain for a few minutes after changing screens.**
- **There may be some dots on the LCD screen which are always on or always off, but it does not affect monitoring. This is normal for all LCD screens.**

At the power on, check that one “bong” sounds and the red alarm lamp and yellow alarm lamp blink once to show that the alarm functions properly.

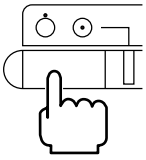


- **When operating on battery power**

  After inserting a fully charged battery pack, press the power switch on the front panel to ON. The power and battery power lamps light, a buzzer sounds and the “CHECK PROGRAM RUNNING” message appears on the screen.

  If the power and battery power lamps do not light and there is no buzzer sound, check the battery condition.

  When the power is turned on again within one hour after using the monitor on battery, the buzzer does not sound.



- **When operating on AC power**

  After grounding and connecting the power cord, press the power switch on the front panel to ON. The power lamp and the AC power lamp light and the “CHECK PROGRAM RUNNING” message appears on the screen.

  If the power lamp does not light, check the power cord connection.

Standby Mode

When the monitor power is turned on, it enters “standby mode” while the monitor is waiting for the electrodes and probe to be attached to the patient. “CHECK ELECTRODES”, “NO PULSE” and “CHECK PROBE” alarms will not be activated. “CHECK PROBE SITE” and “PULSE SEARCH” messages will not be displayed. The monitor changes from standby mode to normal monitoring when the ECG or SpO_2 monitoring starts. The monitoring starts when the connection cord is

connected to the socket on the monitor and electrodes or probe is attached to the patient.

If the monitor power is turned off and on again within 10 seconds, the monitor skips standby mode.

Check After Turning On the Power and During Monitoring

To start monitoring safely and properly, check the following items after turning on the power. If any problem is detected, take the proper countermeasure according to the troubleshooting and maintenance sections.

- There is no fire, smoke or smell.
- The monitor is not too hot.
- The power lamp and standby lamp light.
- Alarm indicators blink once and a bong sounds.
- The start up screen appears and the monitoring screen appears.
- No error message is displayed on the screen.
- The time on the screen is correct.
- The low battery mark does not appear on the screen when operating on battery.
- The monitor does not affect surrounding equipment.
- The data and waveforms are displayed properly.
- Keys, switch and function dials operate properly.
- The touch keys function properly.
- Alarm functions properly.
- There is no trouble in recording (for BSM-4101/4102/4103/4104 monitors).

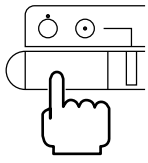
NOTE

After turning the monitor on and when admitting a patient on the monitor, make sure that the time displayed at the upper right of the screen is correct. When the date or time is changed during monitoring, the date and time of all stored data is also changed and may not match the date and time on the printout.

When the monitor is connected to a network

The time on this monitor is automatically adjusted to match the time of the network as long as the monitor is connected to the network. The date and time on all monitors in the network are set to the same setting.

Turning the Power Off



1. Press the power switch on the front panel for more than one second to turn the power off. The screen becomes dark and the power lamp on the front panel turns off.

Check After/Before Turning the Power Off

Check the following items for the next use.

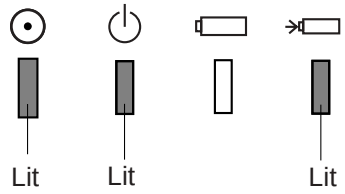
- Previous patient data is deleted.
- Temporarily changed settings are changed back to the previous settings.
- There is no dirt, damage or scratches on the monitor.
- The sensors, probes, transducers, and cables are cleaned and sterilized.
- Accessories are cleaned and stored properly.
- There are enough consumables, such as recording paper, and disposable electrodes for the next use.
- Battery pack is fully charged.
- Battery pack is removed from the monitor when not operating for a long period of time.
- The power switch on the monitor is turned off and the power cord is disconnected from the monitor.
- The monitor is not in a wet place.
- Dead batteries are disposed of properly.
- The medical waste is disposed of properly.
- The monitor is stored properly.

Power and Battery Status Indications

Power and battery status are indicated by four lamps on the front panel. A discharged battery is also indicated by a screen message and alarm.

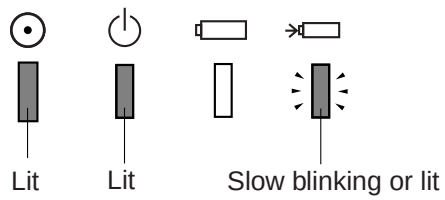
NOTE

When charging the battery with the monitor power switch turned off, check that the power lamp and battery charging lamp light. If the lamps do not light even when the power cord is connected and the battery is inserted, turn the power switch on, check that the battery charging lamp is blinking or lit, then turn the power switch off.



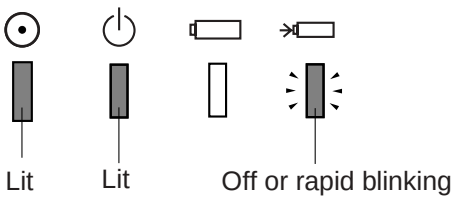
- Operating on AC power and battery is fully charged

  Power lamp: Lit
  AC power lamp: Lit
  Battery power lamp: Off
  Battery charging lamp: Lit



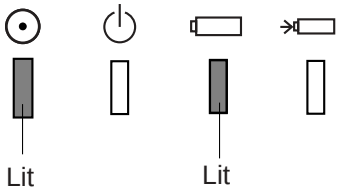
- Operating on AC power and battery is being charged

  Power lamp: Lit
  AC power lamp: Lit
  Battery power lamp: Off
  Battery charging lamp: Slow blinking (once every 2 seconds) or lit



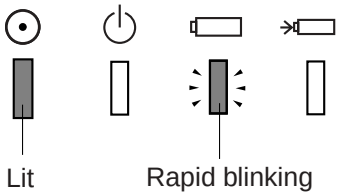
- Operating on AC power with no battery or battery is damaged

  Power lamp: Lit
  AC power lamp: Lit
  Battery power lamp: Off
  Battery charging lamp: Off or rapid blinking (4 times per second)



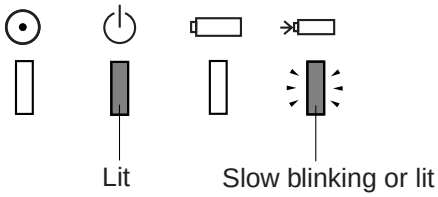
- Operating on battery power

Power lamp:	Lit
AC power lamp:	Off
Battery power lamp:	Lit
Battery charging lamp:	Off



- Operating on battery power and battery needs recharging

Power lamp:	Lit
AC power lamp:	Off
Battery power lamp:	Rapid blinking (4 times per second)
Battery charging lamp:	Off
Screen indication:	“BATTERY WEAK” message
Alarm indication:	Continuous “bing bong” sound and blinking yellow alarm lamp



- No monitoring and charging battery

Power lamp:	Off
AC power lamp:	Lit
Battery power lamp:	Off
Battery charging lamp:	Slow blinking (once every 2 seconds) or lit

Battery Handling and Operation

Safety Information

WARNING

- **Keep the battery pack away from fire.**
- **Keep the battery pack away from children.**
- **Never short-circuit the + and – terminals on the battery pack.**
- **Never disassemble the battery pack.**
- **If the battery pack is damaged and substance inside the battery (potassium hydroxide) contacts the skin or clothes, wash immediately and thoroughly with water.**

CAUTION

- **Do not subject the battery pack to a strong mechanical shock.**
- **Use the battery pack between 10°C (50°F) and 40°C (104°F). Temperatures out of this range affect the working of the battery.**
- **Do not use a battery which is past the expiration date written on the label.**
- **Before disposing of the battery, check with your local solid waste officials for details in your area for recycling options or proper disposal. The battery is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream.**

Battery Handling Procedures

During AC Operation

- Always place an uncharged battery in the monitor during AC operation. This charges it so that you will always have a fully charged battery ready.
- When operating the monitor on AC power for over 3 months, do not leave a fully charged battery in the monitor. Leaving a fully charged battery inside the monitor for a long time causes the battery to deteriorate.
- We recommend having two or more fully charged battery packs ready.

During Battery Operation

- Use a battery until it is fully discharged (BATTERY WEAK message appears), then replace it with a fully charged battery. The battery life will be longer if it is fully discharged before charging it again.
- Replace the battery with a new one after 200 cycles of discharging/charging or after one year, whichever comes first. This is because the battery is a chemical product which gradually deteriorates whether or not it is used.
- We recommend having two or more fully charged battery packs ready.

When Using a Battery for the First Time or After Storage

- Fully recharge the battery before using it for the first time or after storing it for over a month. When the battery is not used, it self-discharges.

When Not Using the Monitor or Battery

- When the monitor is not used, remove the battery. When a charged or discharged battery is left inside the monitor with the power cord unplugged, the battery self-discharges and deteriorates.
- When a battery is not used, fully charge it before storage. When a battery is not used for over one month, fully charge it once a month.
- Store the battery packs under the following conditions.

  Temperature: –20 to 25°C (–4 to 77°F)
  Humidity: 45 to 85% relative humidity

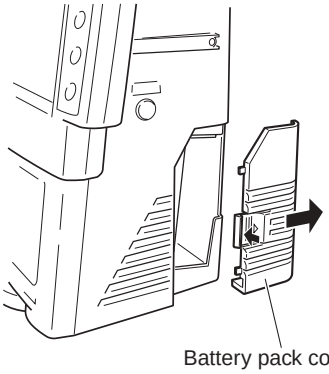
When the BATTERY WEAK Message Appears

Operate the monitor on AC power and/or replace the battery when the BATTERY WEAK message appears.

When the BATTERY WEAK message appears, the battery has approximately 5 to 15 minutes of power left. The yellow alarm lamp lights with a continuous “bing bong” sound.

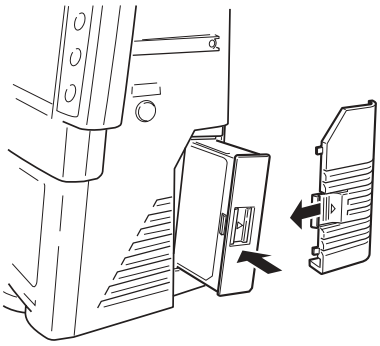
If no AC or battery power is supplied to the monitor, there is no measurement or display but no data is lost.

Inserting or Replacing the Battery



• To insert the battery pack

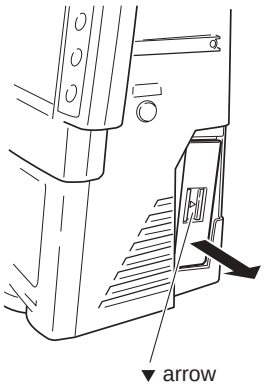
1. Remove the battery pack cover from the right side panel.



2. Slide the battery pack into the monitor until it clicks.

3. Reattach the battery pack cover.

• To remove the battery pack



1. Remove the battery pack cover from the right side panel.

2. Push the slide lever in the ▼ direction and pull out the battery pack.

3. Reattach the battery pack cover.

Charging the Battery

The battery pack can be charged either by the monitor or the locally purchased battery charger. It takes about 15 hours to charge a battery pack on the monitor.

The monitor can operate for about 1 hour with a fully charged battery pack when:

- Used in normal temperature
- Recorder is not used
- No alarm occurs
- No NIBP measurement
- POWER SAVE MODE on the SYSTEM SETUP screen is set to ON.

CAUTION

When charging the battery pack, keep the ambient temperature at approximately 20°C to maintain the optimal battery operation time. If the battery pack is charged at less than 10°C (50°F) or more than 30°C (86°F), the maximum battery operation time will be 20% to 30% less than the optimal operation time.

Charging in the Monitor

During AC operation, the battery is automatically charged without interrupting monitoring. It takes approximately 15 hours of continuous charging to fully charge the battery pack. After 15 hours of continuous charging, the monitor automatically switches to trickle charging mode to maintain the battery pack fully charged. Trickle charging is necessary because the battery pack can self-discharge even when it is not in use.

NOTE

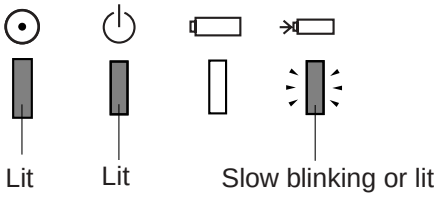
If the 15 hours of continuous normal charging is disrupted for more than one hour by power failure in the main power supply or by temporary removal of the battery pack from the monitor, the monitor's normal charging circuit is reset, and the battery pack is charged for another 15 hours regardless of how many hours it was charged before the disruption. This deteriorates the battery.

1. Connect the power cord to the monitor and the AC outlet.

2. Insert the battery pack into the monitor. The monitor charges the battery pack regardless of whether the monitor power switch is on or off.

   During charging, the battery charging lamp on the front panel blinks.

   After 15 hours, the battery charging lamp is continuously lit and the battery charging is completed.



Charging with the Battery Charger

Refer to the battery charger manual.

Section 3 Changing System Setup Settings

Displaying the SYSTEM SETUP Screen 3.2
- Changing Settings 3.3
- Closing the SYSTEM SETUP Screen and Displaying the Monitoring Screen 3.3

List and Explanation of the SYSTEM SETUP Settings 3.4
- List of All Settings 3.4
- Site Setting (SITE) 3.6
- Display Settings (DISPLAY SETUP) 3.6
- Bed ID Setting (BED ID SETUP) 3.8
- Parameter and Other Settings (PARAMETER SETUP) 3.8
- NIBP Settings (NIBP SETUP) 3.10
- Alarm Settings (ALARM SETUP) 3.11
- Unit Settings (UNITS SETUP) 3.14
- Color Settings (COLOR SETUP) 3.15
- Recording Settings (RECORD SETUP) 3.17
- Other Settings (OTHER SETUP) 3.18
- Alarm Master Settings (ALARM MASTER) 3.19
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Initializing the System 3.25

The section explains how to change settings after the monitor is installed and before monitoring waveforms.

The initial settings on the SYSTEM SETUP screen must be changed before monitoring. Changing these settings during monitoring interrupts monitoring.

All other settings can be changed any time without interrupting monitoring.

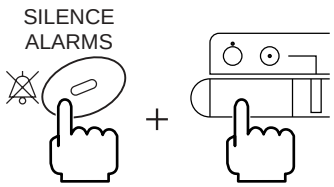
This section also explains how to initialize the system. This procedure returns all settings to the factory default settings and deletes all stored data in memory.

Displaying the SYSTEM SETUP Screen

WARNING

This procedure interrupts all monitoring. Only change these settings before or after monitoring.

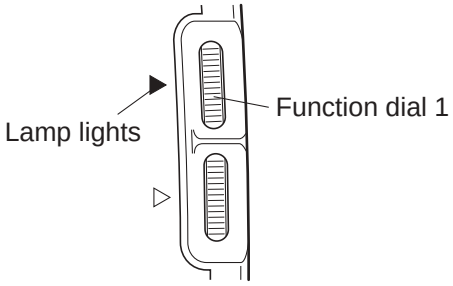
1. Turn the monitor power off.



2. Press the power switch while pressing the SILENCE ALARMS key on the front panel until the DIAGNOSTIC CHECK screen is displayed.

3. Touch the “SYSTEM SETUP” key. The SYSTEM SETUP screen appears.

Changing Settings



1. Touch the desired item on the SYSTEM SETUP screen. A setup screen for that item appears.
2. Touch a setting key on the screen or use the function dials on the front panel to set the condition. A function dial can be used when its lamp on the front panel lights.
3. Touch the “RETURN” key to return to the SYSTEM SETUP screen.
4. Repeat steps 1 to 3 to change other setup settings.

Closing the SYSTEM SETUP Screen and Displaying the Monitoring Screen

1. After you change all desired settings, touch the “RETURN” key on the SYSTEM SETUP screen. The new settings are entered and the screen returns to the DIAGNOSTIC CHECK screen.
2. Touch the “MONITOR MODE” key. After a few seconds, the monitoring screen appears.

List and Explanation of the SYSTEM SETUP Settings

List of All Settings

The factory default settings are underlined.

SETUP type	Item		Setting Conditions
SITE			OR, ICU, NICU
DISPLAY SETUP	WAVE DISPLAY		FIXED, MOVING
	DISPLAY COLOR MODE		PARAMETER, ALARM
	POWER SAVE MODE		ON, OFF
	FILL IN WAVEFORM		ON, OFF
BED ID SETUP			Up to 8 alphanumerics OR: OR-001, ICU: ICU-001, NICU: NICU-001
PARAMETER SETUP	LINE FREQUENCY		AUTO, 50 Hz, 60 Hz
	ECG 12 LEAD HUM FILTER		OFF, AUTO, 50 Hz, 60 Hz
	PRESS FILTER		10 Hz, 20 Hz
	ECG ELECTRODE		IEC, AHA
	NOISE REDUCTION ON IMPEDANCE RESP		ON, OFF
NIBP SETUP	NIBP MODE AFTER STAT		MANUAL, 2 min, 2.5 min, 5 min, 10 min, 15 min, 30 min
	NIBP COMPLETION SOUND		ON, OFF OR: ON ICU, NICU: OFF
	NIBP STAT MODE		STAT, 1 min
	INTERVAL MASTER		MANUAL, STAT, 2 min, 2.5 min, 5 min, 10 min, 15 min, 30 min, 1 h, 2 h, 4 h, 8 h
	OLD NIBP DATA AFTER		DIM, HIDE 10 min, 30 min, 1h, 24h OR: 10 min ICU, NICU: 30 min
ALARM SETUP	SILENCE TIME		1 min, 2 min
	ALARM LIMIT DISPLAY		MARK ON, VALUES OR, ICU: MARK ON, NICU: VALUES
	EXIT SLEEP MODE ON ALARM		YES, NO
	SUSPEND MONITORING ON DATA DELETION		YES, NO
	SUSPEND ALARM TIME		0 min, 1 min, 3 min
	ALARM LEVEL	HR	CRISIS, WARNING, ADVISORY
		SpO2	CRISIS, WARNING, ADVISORY
		PRESS	CRISIS, WARNING, ADVISORY
		NIBP	CRISIS, WARNING, ADVISORY
		APNEA	CRISIS, WARNING, ADVISORY OR, ICU: WARNING, NICU: CRISIS
		EXTERNAL	CRISIS, WARNING, ADVISORY
		ECG CHECK ELECTRODES	WARNING, ADVISORY
		SpO2 CHECK PROBE	WARNING, ADVISORY
		VPC RUN	CRISIS, WARNING, ADVISORY
		COUPLET	CRISIS, WARNING, ADVISORY
		EARLY VPC	CRISIS, WARNING, ADVISORY
		BIGEMINY	CRISIS, WARNING, ADVISORY
		FREQ VPC	CRISIS, WARNING, ADVISORY
		TACHYCARDIA	CRISIS, WARNING, ADVISORY
		BRADYCARDIA	CRISIS, WARNING, ADVISORY OR, ICU: WARNING, NICU: CRISIS
UNITS SETUP	PRESSURE UNIT		mmHg, kPa
	TEMPERATURE UNIT		C, F
	HEIGHT UNIT		cm, inch
	WEIGHT UNIT		kg, pound
	ST UNIT		mV, mm

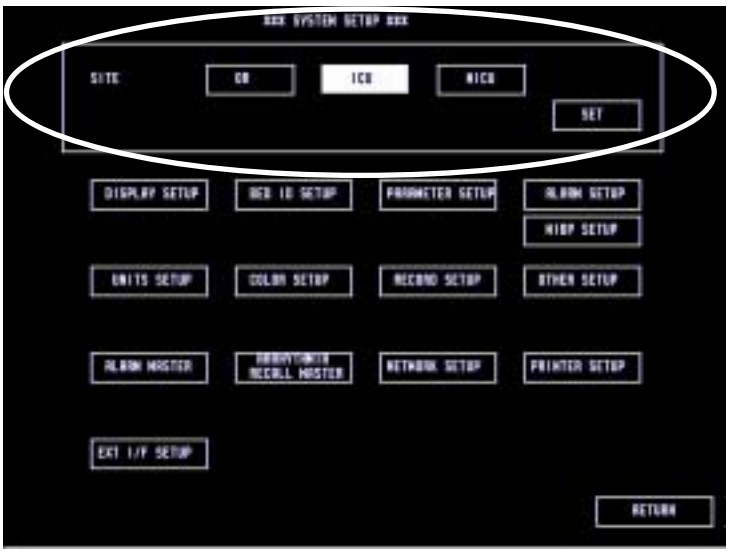
SETUP type	Item		Setting Conditions
COLOR SETUP	PARAMETER PARAMETER (PRESS) PARAMETER (TEMP) PARAMETER (EXT)		Green, scarlet, pink, light blue, purple, pale yellow, pale green, sky blue, white (black)*, orange, yellow, red Default settings: ECG: green RESP/CO2: white NIBP: pink SpO2: light blue FiO2: green CO: white PRESS/ART/ART-2/RAD/AO/DORS/FEM/UA: red PRESS-2/UV/CVP/RAP: sky blue PRESS-3/PAP/RVP: yellow ICP/ICP-2/ICP-3: pale yellow TEMP/Tskin/Tskin-2: orange TEMP-2/Trect/Tcore/Tnaso/ Teso/Ttymp/Tblad/Taxil/delta-T: pale yellow Fi/EtCO2: white Fi/EtN2O: sky blue Fi/EtO2: green Fi/EtHAL: red Fi/EtISO: purple Fi/EtENF: orange Fi/EtDES: light blue Fi/EtSEV: yellow VENT: white BIS: orange CNIBP: orange
	BACKGROUND		BLACK, WHITE
	ALARM MODE		Green, scarlet, pink, light blue, purple, pale yellow, pale green, sky blue, white (black)*
RECORD SETUP**	MANUAL RECORD		REAL TIME, DELAY
	MANUAL RECORD TIME		CONTINUOUS, 10 sec, 20 sec, 30 sec
	PERIODIC FREE INTERVAL		1 to 120 min (1 min steps), 15 min
OTHER SETUP	SYNC SOUND PITCH		LOW, MIDDLE, HIGH
	ALARM INDICATOR QRS SYNC		ON, OFF OR, NICU: OFF ICU: ON
	FUNCTION DIAL DIRECTION		NORMAL, REVERSE
	ZB-800P TYPE		8, A
	TIME ZONE		0 to ±12:00 in 30 min steps, +9:00
ALARM MASTER	VITAL		See explanation in following pages.
	ARRHYTHMIA		See explanation in following pages.
ARRHYTHMIA RECALL MASTER			See explanation in following pages.
NETWORK SETUP***	GROUP		GROUP 01 to GROUP 16, GROUP 01
	DEFAULT GATEWAY		255.255.255.255, 000.000.000.000
	IP ADDRESS SETUP		AUTO, MANUAL
	MANUAL IP ADDRESS		255.255.255.255, 000.000.000.000
	MANUAL SUBNET MASK		255.255.255.255, 000.000.000.000
PRINTER SETUP	PRINTER SETUP	PAPER SIZE	A4, LETTER
		PRINTER TYPE	MONOCHROME, COLOR
		IP ADDRESS	255.255.255.255, 000.000.000.000
	PRINTER NAME		Up to 8 alphanumerics, lp
	HOSPITAL NAME		Up to 32 alphanumerics
EXT I/F SETUP			RS-232C information of the interface connected to the monitor. Refer to the interface manual.

* If black is selected for the background color and black for the parameter color, the parameter appears in white.

** When recording on a central monitor recorder in the network from BSM-4111/4112/4113/4114 monitors: MANUAL RECORD is fixed at REAL TIME and any MANUAL RECORD TIME setting can be selected but when CONTINUOUS is selected, the manual record time is fixed at 30 sec and PERIODIC FREE INTERVAL setting is not available.

*** These items can only be set when the optional QI-101P network card or QI-111P network printer card is installed in the monitor.

Site Setting (SITE)



SITE: OR, ICU, NICU

Select the site according to the environment. The default settings, including alarm upper and lower limit settings, differ according to site.

OR: The “BYPASS” key is displayed on the MENU window. Sleep mode is not available.

ICU, NICU: The “SUSPEND MONITORING” key is displayed on the MENU window. Sleep mode is available.

When the “BYPASS” or “SUSPEND MONITORING” key is pressed,

- All alarms are suspended until the key is pressed again. Refer to Section 6.
- NIBP measurement in STAT and Auto mode is suspended until the ◇/▽ NIBP START/STOP key is pressed. Refer to Section 14.

Select the site and touch the “SET” key to change the site.

Display Settings (DISPLAY SETUP)

WAVE DISPLAY: FIXED, MOVING

Select waveform sweep mode on the monitoring screen.

FIXED: Waveform does not sweep; it is refreshed from the left.

MOVING: Waveform sweeps from the right.

DISPLAY COLOR MODE: PARAMETER, ALARM

There are two color display modes.

PARAMETER: A different color can be set for each parameter. When an alarm occurs, the alarmed parameter data is highlighted.

ALARM: The same color selected at ALARM MODE COLOR of the COLOR SETUP is set for all parameters. When an alarm occurs, the alarmed parameter color changes to red or yellow according to the alarm level set at ALARM LEVEL of the ALARM SETUP.

CRISIS: red

WARNING: yellow

ADVISORY: yellow

POWER SAVE MODE: ON, OFF

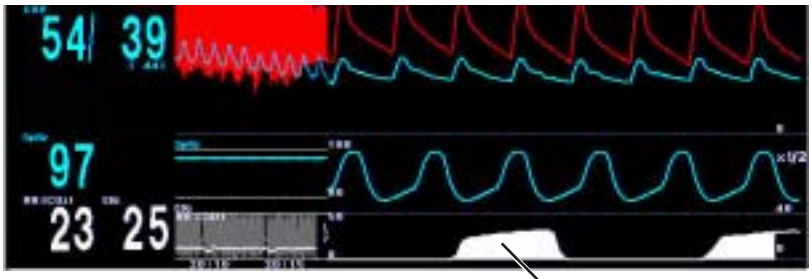
When operating the monitor on battery power, the brightness of the screen can be adjusted to save battery power.

ON: Dim, longer battery operation time

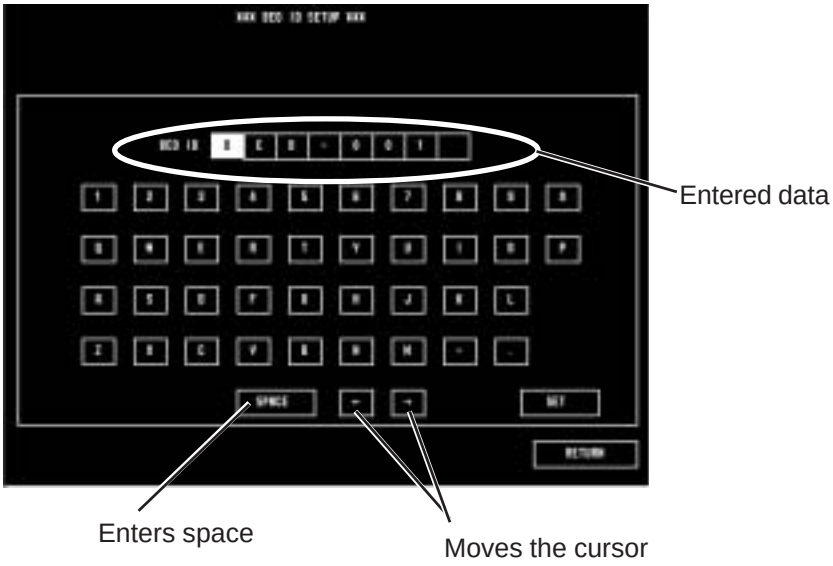
OFF: Normal screen brightness, shorter battery operation time

FILL IN WAVEFORM: ON, OFF

When set to ON, the CO_2 and gas waveforms are filled in.



Bed ID Setting (BED ID SETUP)



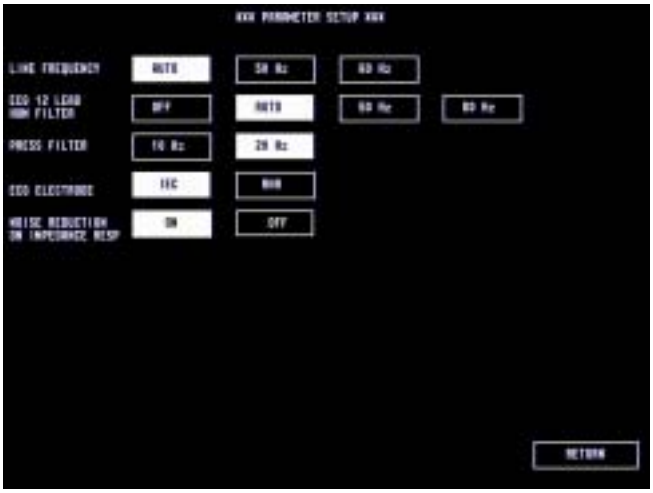
Enter an identification name for the bed. Up to 8 alphanumeric characters can be entered.

CAUTION

When the monitor is connected to a central network, set the Bed ID on the monitor to correctly identify the bed on the central monitor.

1. Touch the desired letters and numbers to enter the bed ID.
2. Touch the “SET” key to register the bed ID.
3. Touch the “RETURN” key to return to the SYSTEM SETUP screen.

Parameter and Other Settings (PARAMETER SETUP)



LINE FREQUENCY: AUTO, 50 Hz, 60 Hz

Select line frequency. In normal use, set to AUTO.

NOTE

When operating on battery, make sure that the appropriate line frequency is selected. Otherwise, noise may interfere on the pulse waveform.

AUTO: Automatically detects the AC line frequency
50 Hz: Set to 50 when operating on battery only in a 50 Hz area
60 Hz: Set to 60 when operating on battery only in a 60 Hz area

ECG 12 LEAD HUM FILTER: OFF, AUTO, 50 Hz, 60 Hz

Select the hum filter for 12 lead ECG monitoring. In normal use, set to AUTO.

NOTE

When operating on battery, make sure that the appropriate line frequency is selected. Otherwise, noise may interfere on the ECG waveforms.

OFF: Hum filter is turned off
AUTO: Automatically detects the AC line frequency
50 Hz: Set to 50 when operating on battery only in a 50 Hz area
60 Hz: Set to 60 when operating on battery only in a 60 Hz area

PRESS FILTER: 10 Hz, 20 Hz

Select the noise filter for IBP monitoring. For normal monitoring, set the filter to 20 Hz. To see the IBP waveforms in detail, set the filter to 10 Hz.

ECG ELECTRODE: IEC, AHA

Select the electrode lead type.
IEC: R, L, F, RF, C
AHA: RA, LA, LL, RL, V

NOISE REDUCTION ON IMPEDANCE RESP: ON, OFF

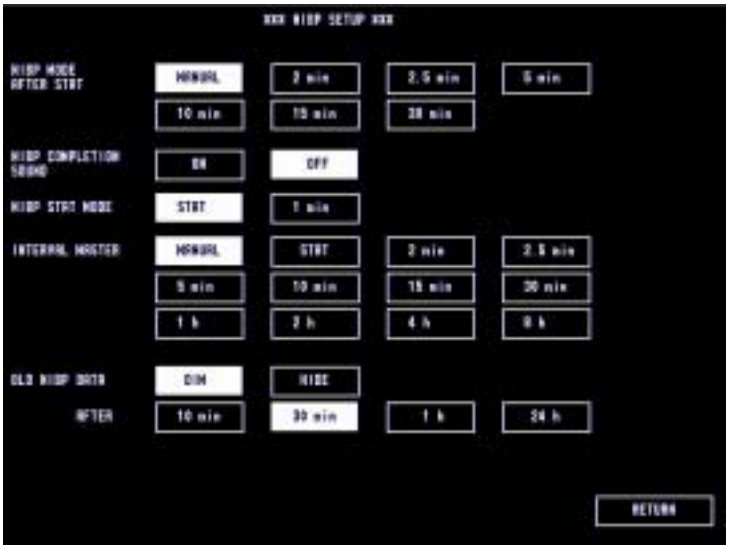
In the impedance method, noise from the heart beat may interfere on the respiration waveform due to electrode position, and the respiration rate may increase to almost the same rate as the heart rate. In such a case, set this setting to ON to reduce noise interference on the respiration waveform.

If the respiration rate is miscounted in the thermistor method, set this item to OFF.

NOTE

When this item is set to ON and the timing of the respiration and heart beat coincide, respiration rate may not be counted. In such a case, set this item to OFF or check the patient's respiration by observing the patient's chest movement or the respiration waveform on the monitoring screen.

NIBP Settings (NIBP SETUP)



NIBP MODE AFTER STAT: MANUAL, 2, 2.5, 5, 10, 15 or 30 min

The NIBP measurement mode after completing STAT (continuous) measurement changes to the Manual mode or Auto mode with the selected interval.

NIBP COMPLETION SOUND: ON, OFF

ON: When NIBP measurement is completed, one “bong” sounds.

OFF: No sound. However, when the STAT mode is selected for the NIBP measurement, one “bong” sounds after completing STAT measurement.

NIBP STAT MODE: STAT, 1 min

There are two modes for STAT NIBP measurement.

STAT: Measure NIBP as many times as possible over a 15 minute period.

1 min: Measure NIBP every minute for a 15 minute period.

INTERVAL MASTER: MANUAL, STAT, 2, 2.5, 5, 10, 15, 30 min, 1, 2, 4 or 8 h

Select the NIBP measurement mode to be set when the monitor is turned off for more than 30 minutes or the monitor is initialized.

OLD NIBP DATA: DIM, HIDE

AFTER: 10 min, 30 min, 1h, 24h

Select whether to dim or hide the NIBP data after NIBP measurement and how long to wait after NIBP measurement to dim or hide it.

Alarm Settings (ALARM SETUP)

SILENCE TIME: 1 min, 2 min

The interval for suspending an alarm can be selected.

ALARM LIMIT DISPLAY: MARK ON, VALUES

MARK ON: The Vital Signs Alarm Off mark is displayed beside the parameter value whose vital signs alarm is set to OFF.

VALUES: The upper/lower alarm limits are displayed beside parameter values.

EXIT SLEEP MODE ON ALARM: YES, NO

YES: When an alarm occurs during sleep mode, the sleep mode is exited and the monitoring screen appears.

NO: The sleep mode continues even when an alarm occurs.

SUSPEND MONITORING ON DATA DELETION

Select whether to suspend monitoring when the YES key is pressed on the DELETE DATA window. While monitoring is suspended, all alarms are suspended.

YES: Deletes data and suspends monitoring

NO: Deletes data and does not suspend monitoring

SUSPEND ALARM TIME

Select when to release monitoring suspension and resume alarms.

0 min: Alarms resume immediately when heart rate, SpO_2, IBP, CNIBP or $EtCO_2$ (except $EtCO_2$ measured by AG-920RA multigas unit) is monitored or when NIBP is measured.

1 min: Alarms resume when heart rate, SpO_2, IBP, CNIBP or $EtCO_2$ (except $EtCO_2$ measured by AG-920RA multigas unit) is monitored properly for 1 minute or when NIBP is measured.

3 min: Alarms resume when heart rate, SpO_2, IBP, CNIBP or $EtCO_2$ (except $EtCO_2$ measured by AG-920RA multigas unit) is monitored properly for 3 minutes or when NIBP is measured.

HR ALARM LEVEL: CRISIS, WARNING, ADVISORY

Heart rate alarm level and alarm indicator color can be selected. See “Alarm Indications” in Section 6.

CRISIS: The heart rate data are highlighted with a continuous “pip” sound and red blinking lamp.

WARNING: The heart rate data are highlighted with a continuous “bing bong” sound and yellow blinking lamp.

ADVISORY: The heart rate data are highlighted with a “bong” sound every 20 seconds and yellow lamp lit.

SpO2 ALARM LEVEL: CRISIS, WARNING, ADVISORY

SpO_2 alarm level and alarm indicator color can be selected. When the sync sound is synchronized with the SpO_2 pulse, the pulse rate alarm level is also set. See “Alarm Indications” in Section 6.

CRISIS: The SpO_2 and pulse rate data are highlighted with a continuous “pip” sound and red blinking lamp.

WARNING: The SpO_2 and pulse rate data are highlighted with a continuous “bing bong” sound and yellow blinking lamp.

ADVISORY: The SpO_2 and pulse rate data are highlighted with a “bong” sound every 20 seconds and yellow lamp lit.

PRESS ALARM LEVEL: CRISIS, WARNING, ADVISORY

IBP alarm level and alarm indicator color can be selected. When the sync sound is synchronized with the blood pressure pulse, the pulse rate alarm level is also set. See “Alarm Indications” in Section 6.

CRISIS: The IBP and pulse rate data are highlighted with a continuous “pip” sound and red blinking lamp.

WARNING: The IBP and pulse rate data are highlighted with a continuous “bing bong” sound and yellow blinking lamp.

ADVISORY: The IBP and pulse rate data are highlighted with a “bong” sound every 20 seconds and yellow lamp lit.

NIBP ALARM LEVEL: CRISIS, WARNING, ADVISORY

NIBP alarm level and alarm indicator color can be selected. See “Alarm Indications” in Section 6.

CRISIS: The NIBP data are highlighted with a continuous “pip” sound and red blinking lamp.

WARNING: The NIBP data are highlighted with a continuous “bing bong” sound and yellow blinking lamp.

ADVISORY: The NIBP data are highlighted with a “bong” sound every 20 seconds and yellow lamp lit.

APNEA ALARM LEVEL: CRISIS, WARNING, ADVISORY

APNEA alarm level and alarm indicator color can be selected. See “Alarm Indications” in Section 6.

CRISIS: The “APNEA” message is highlighted with a continuous “pip” sound and red blinking lamp.

WARNING: The “APNEA” message is highlighted with a continuous “bing bong” sound and yellow blinking lamp.

ADVISORY: The “APNEA” message is highlighted with a “bong” sound every 20 seconds and yellow lamp lit.

EXTERNAL ALARM LEVEL: CRISIS, WARNING, ADVISORY

The alarm level and alarm indicator color for the alarm occurring on the external instrument connected to the monitor can be selected. See “Alarm Indications” in

Section 6.

CRISIS: The external instrument data are highlighted with a continuous “pip” sound and red blinking lamp.

WARNING: The external instrument data are highlighted with a continuous “bing bong” sound and yellow blinking lamp.

ADVISORY: The external instrument data are highlighted with a “bong” sound every 20 seconds and yellow lamp lit.

ECG CHECK ELECTRODES ALARM LEVEL: WARNING, ADVISORY

CHECK ELECTRODES alarm level and alarm indicator color can be selected. See “Alarm Indications” in Section 6.

WARNING: The “CHECK ELECTRODES ” message is highlighted with a continuous “bing bong” sound and yellow blinking lamp.

ADVISORY: The “CHECK ELECTRODES ” message is highlighted with a “bong” sound every 20 seconds and yellow lamp lit.

SpO_2 CHECK PROBE ALARM LEVEL: WARNING, ADVISORY

The alarm level and alarm indicator color for the CHECK PROBE and NO PULSE alarm can be selected. See “Alarm Indications” in Section 6.

WARNING: The SpO2 ALARM message is highlighted with a continuous “bing bong” sound and yellow blinking lamp.

ADVISORY: The SpO2 ALARM message is highlighted with a “bong” sound every 20 seconds and yellow lamp lit.

VPC RUN, COUPLET, EARLY VPC, BIGEMINY, FREQ VPC ALARM LEVEL: CRISIS, WARNING, ADVISORY

The alarm level and alarm indicator color for the VPC RUN, COUPLET, EARLY VPC, BIGEMINY and FREQ VPC arrhythmias can be selected individually. See “Alarm Indications” in Section 6.

CRISIS: The arrhythmia message is highlighted with a continuous “pip” sound and red blinking lamp.

WARNING: The arrhythmia message is highlighted with a continuous “bing bong” sound and yellow blinking lamp.

ADVISORY: The arrhythmia message is highlighted with a “bong” sound every 20 seconds and yellow lamp lit.

TACHYCARDIA, BRADYCARDIA ALARM LEVEL: CRISIS, WARNING, ADVISORY

The alarm level and alarm indicator color for the TACHYCARDIA and BRADYCARDIA arrhythmias can be selected. See “Alarm Indications” in Section 6. When the heart rate alarm level and tachycardia or bradycardia alarm level differ, the higher level is used.

CRISIS: The arrhythmia message is highlighted with a continuous “pip” sound and red blinking lamp.

WARNING: The arrhythmia message is highlighted with a continuous “bing bong” sound and yellow blinking lamp.

ADVISORY: The arrhythmia message is highlighted with a “bong” sound every 20 seconds and yellow lamp lit.

Unit Settings (UNITS SETUP)

PRESSURE UNIT: mmHg, kPa
Select the unit for NIBP, IBP and CO_2.

TEMPERATURE UNIT: C, F
Select the unit for temperature.

HEIGHT UNIT: cm, inch
Select the unit for height.

WEIGHT UNIT: kg, pound
Select the unit for weight.

ST UNIT: mV, mm
Select the unit for ST level.

Color Settings (COLOR SETUP)

PARAMETER COLOR

The color for each parameter display can be selected. Available colors are: green, scarlet, pink, light blue, purple, pale yellow, pale green, sky blue, white (black), orange, yellow and red.

If black is selected for the background color and black for the parameter color, the parameter appears in white.

To display the parameters in different colors, the DISPLAY COLOR MODE of the DISPLAY SETUP must be set to PARAMETER.

1. Touch the “PARAMETER” key to change color for ECG, SpO_2, NIBP, CO, RESP/CO_2 and FiO_2.

   Touch the “PARAMETER (PRESS)” key to change color for IBP parameters.

   Touch the “PARAMETER (TEMP)” key to change color for temperature parameters.

   Touch the “PARAMETER (EXT)” key to change color for the parameters monitored by using the external unit.

2. Touch the parameter you want to change the color of.

3. Touch the desired color for the parameter.

4. Repeat steps 2 and 3 to set a color for other parameters.

ALARM MODE COLOR

The color for all parameters display can be selected. When ALARM is selected for the DISPLAY COLOR MODE of the DISPLAY SETUP, all parameters are displayed in the same color. Available colors are: green, scarlet, pink, light blue, purple, pale yellow, pale green, sky blue and white (black).

When an alarm occurs, the alarmed parameter changes to red or yellow according to the alarm level set at ALARM LEVEL of the ALARM SETUP.

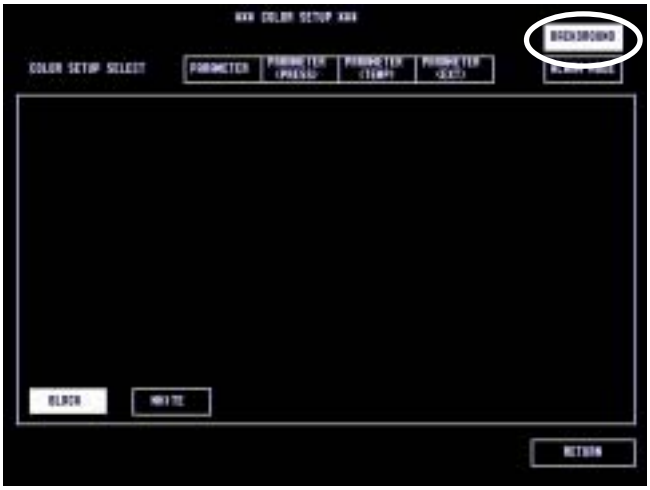
If black is selected for the background color and black for the parameter color, the parameter appears in white.

1. Touch the “ALARM MODE COLOR” key.

2. Touch the desired color.

BACKGROUND: BLACK, WHITE

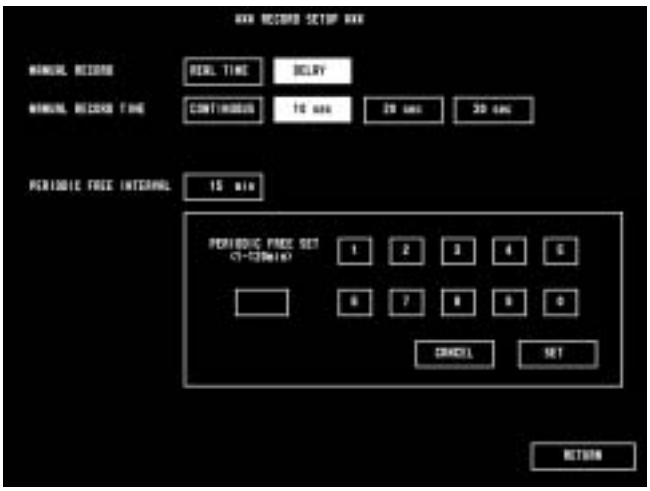
The background color of the monitoring screen can be selected.



1. Touch the “BACKGROUND” key.

2. Touch the “BLACK” or “WHITE” key.

Recording Settings (RECORD SETUP)



MANUAL RECORD: REAL TIME, DELAY

There are two manual recording modes.

REAL TIME: The beginning of the recorded waveform is when the “RECORD” key on the screen is touched or the record key on the front panel is pressed.

DELAY: The beginning of the recorded waveform is 8 seconds before the “RECORD” key on the screen is touched or 8 seconds before the record key on the front panel is pressed.

When manually recording on a central monitor recorder in the central monitor network from BSM-4111/4112/4113/4114 monitors, this setting is fixed at REAL TIME.

MANUAL RECORD TIME: CONTINUOUS, 10 sec, 20 sec, 30 sec

Select the length for manual recording. When CONTINUOUS is selected, the recording starts when the “RECORD” key on the screen is touched or the record key on the front panel is pressed and stops when the “STOP REC” key on the screen is touched or the record key on the front panel is pressed.

When manually recording on a central monitor recorder in the central monitor network from BSM-4111/4112/4113/4114 monitors, this setting is automatically changed to 30 sec when CONTINUOUS is selected.

PERIODIC FREE INTERVAL: 1 to 120 min

You can select the FREE time interval from 1 to 120 min in 1 min steps for periodic recording. See “Setting Periodic Recording” in Section 8. This setting is not available for the BSM-4111/4112/4113/4114 monitors.

1. Enter the numbers by touching the number keys.

2. Touch the “SET” key to enter the value.

Other Settings (OTHER SETUP)

SYNC SOUND PITCH: LOW, MIDDLE, HIGH

High, middle, or low pitch synchronized sound can be selected.

ALARM INDICATOR QRS SYNC: ON, OFF

ON: The green lamp blinks in synchronization with the QRS.

OFF: The alarm indicator does not blink.

FUNCTION DIAL DIRECTION: NORMAL, REVERSE

Selects the direction of the function dials 1 and 2 operation on all screens as below except for the SYSTEM SETUP screen.

NORMAL:

	When setting alarm limits	When scrolling list data	When scrolling trendgraph data
Clockwise	Increases	Newer data	Newer data
Counterclockwise	Decreases	Older data	Older data

REVERSE:

	When setting alarm limits	When scrolling list data	When scrolling trendgraph data
Clockwise	Decreases	Older data	Older data
Counterclockwise	Increases	Newer data	Newer data

ZB-800P TYPE: 8, A

Select the parameter group for transmitting data by the ZB-800P transmitter. CO_2 data cannot be received by a monitor on which CO_2 is not available.

8: ECG, SpO_2, NIBP, IBP connected to multi-parameter socket 1 or 2, respiration and temperature

A: ECG, SpO_2, NIBP, IBP connected to multi-parameter socket 1 or 2, temperature and CO_2 or respiration

TIME ZONE: 0 to ±12:00

Set the time zone in respect to GMT (Greenwich Mean Time). The time difference can be selected in 30 minute steps.

This setting must be the same on all monitors in the same network. Otherwise data communication problems may occur.

Alarm Master Settings (ALARM MASTER)

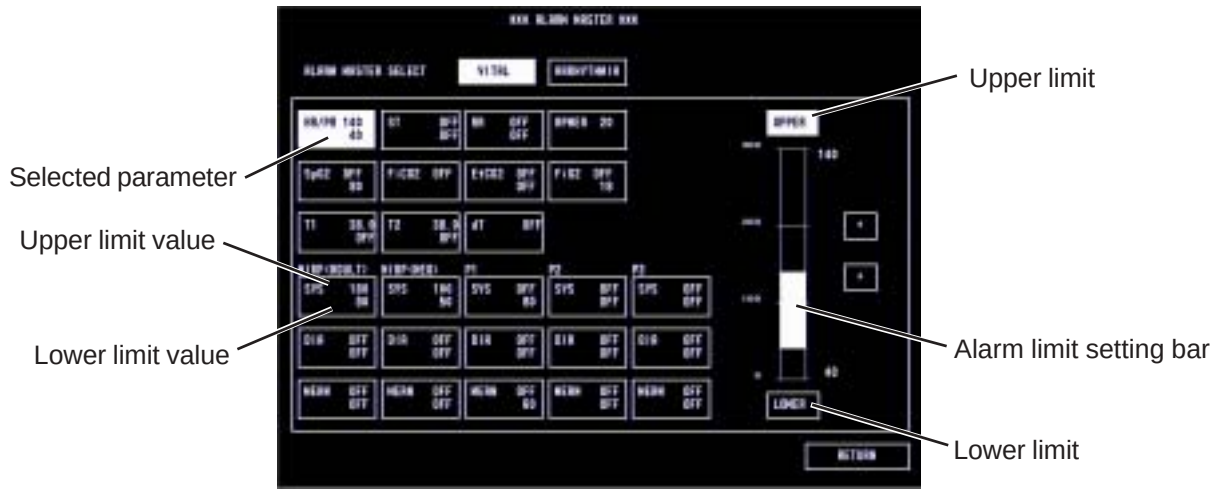
For fast and easy alarm setup, a group of alarm items can be set all together at one time. For example, there may be typical alarm settings at your hospital, or you may have certain alarm settings for certain patients.

Even when alarms are set by an alarm master, individual alarm settings in the alarm master can still be changed on the VITAL ALARM or ARRHYTH ALARM window or the alarm setting in each parameter setup window.

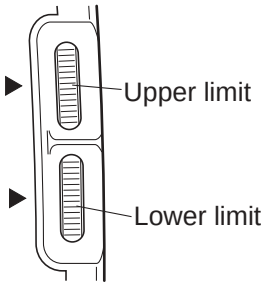
VITAL ALARM MASTER

Set the vital alarm master settings. If the upper limit is set to a value above the maximum or the lower limit is set to a value below the minimum, the alarm for that upper/lower limit is automatically set to OFF.

1. Touch the “VITAL” key.



2. Touch the parameter you want to change the alarm setting for.



3. Use the function dials to change settings.

   Or,

   1) Touch the “UPPER” key to set the upper limit or touch the “LOWER” key to set the lower limit.

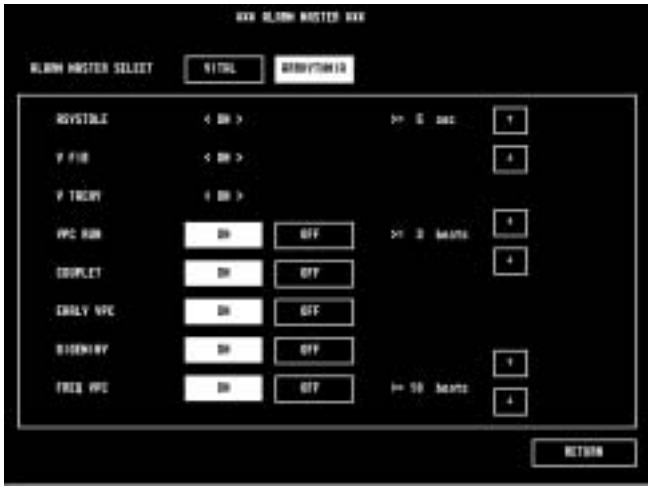
   2) Touch the desired level on the setting bar. Touch the [↑] or [↓] key to adjust the setting.

4. Repeat steps 2 and 3 to change other parameter alarm settings.

ARRHYTHMIA ALARM MASTER

Set the arrhythmia alarm master settings.

1. Touch the “ARRHYTHMIA” key.



2. Touch the “ON” or “OFF” key for each arrhythmia type to set it on or off.

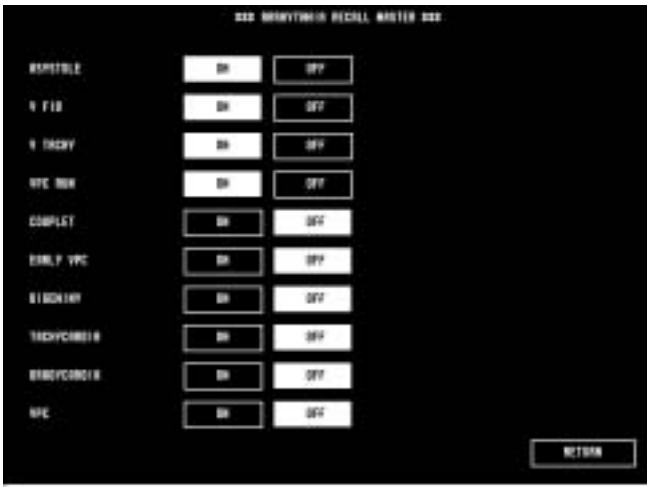
3. For “ASYSTOLE”, “VPC RUN” and “FREQ VPC”, set the detecting condition with the [↑] or [↓] key.

Arrhythmia Recall Master Settings (ARRHYTHMIA RECALL MASTER)

For fast and easy arrhythmia recall setup, a group of arrhythmia recall items can be set all together at one time.

Even when arrhythmia recall is set by an arrhythmia recall master, individual settings in the arrhythmia recall settings can still be changed on the ARRHYTH RECALL window.

Touch the “ON” or “OFF” key for an individual arrhythmia type to set it on or off for creating arrhythmia recall files.



Network Settings (NETWORK SETUP)

Change the network settings when using the optional QI-101P network card or QI-111P network printer card. For details, contact your Nihon Kohden distributor.

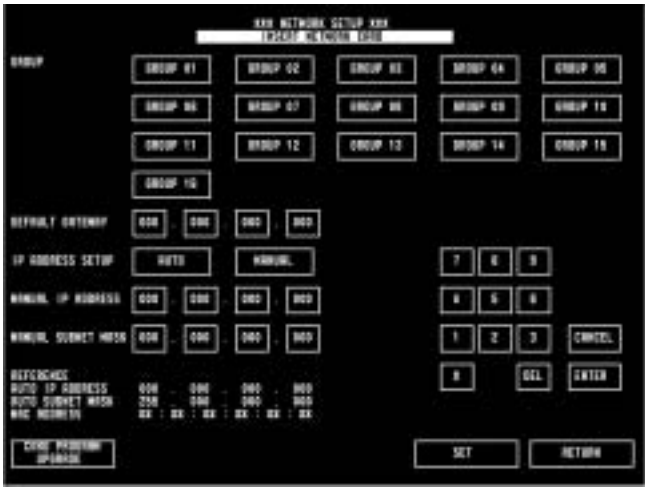
The "CARD PROGRAM UPGRADE" key is for upgrading the QI-101P network card and QI-111P network printer card. For details, refer to the upgrade procedure for the network card and network printer card.

CAUTION

- **The network must be managed by the network administrator. Make sure that each monitor in the network has a different IP address. Otherwise, data communication cannot be performed properly. When adding a unit to an already operating network, set the IP address on the monitor before connecting the monitor to the network.**
- **When the monitor is connected to a central monitor network, set the Bed Name (Bed ID) and Group Name on the monitor. Otherwise, the default settings are used for the bed name and group name and the bed may be incorrectly identified on the central monitor.**

NOTE

To change the settings, the network card and network printer card must be inserted in the PC card slot on the monitor. Otherwise the NETWORK SETUP setting screen cannot be displayed.



When the monitor is installed in a network for the first time, do the following procedure to acquire information of the network to which the monitor is connected.

1. Check that IP ADDRESS SETUP is set to AUTO on the NETWORK SETUP screen.

2. Turn the monitor power off, then turn it on.

3. Check that the communicating icon appears on the monitoring screen. Wait for 20 seconds.

4. Turn the monitor power off.

5. Call up the SYSTEM SETUP screen and display the NETWORK SETUP screen.

GROUP: GROUP 01 to 16
Assign a group name for the bedside monitor. When the monitor has acquired the information of the network to which it is connected, the group names assigned by the central monitor appear. Select the group name from this list for the bedside monitor. For details, refer to the central monitor operator's manual.

DEFAULT GATEWAY: 0.0.0.0 to 255.255.255.255
Set the IP address of the default gateway when it exists in the network.

IP ADDRESS SETUP: AUTO, MANUAL
When set to AUTO, the IP address and subnet mask are set automatically.

MANUAL IP ADDRESS: 0.0.0.0 to 255.255.255.255
When IP ADDRESS SETUP is set to MANUAL, set the IP address of the bedside monitor manually.

MANUAL SUBNET MASK: 0.0.0.0 to 255.255.255.255
When IP ADDRESS SETUP is set to MANUAL, set the subnet mask of the bedside monitor manually.

Network Printer Settings (PRINTER SETUP)

Change the network printer settings when using the optional QI-111P network printer card. For details, contact your Nihon Kohden distributor.

PRINTER SETUP

PAPER SIZE: A4, LETTER

Select the size of the paper used on the network printer.

PRINTER TYPE: MONOCHROME, COLOR

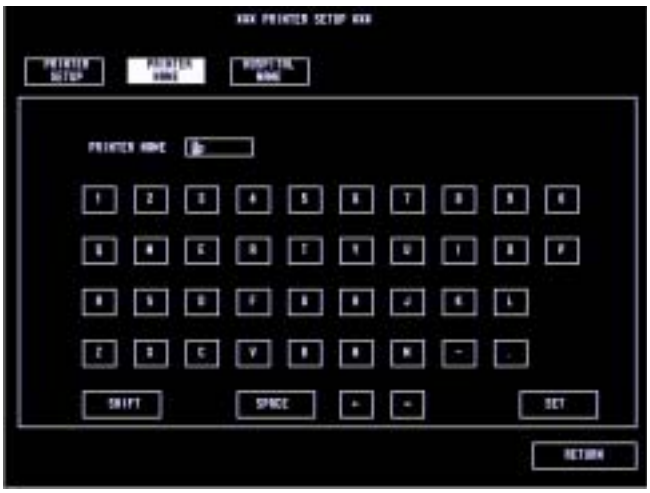
Select the color mode of the network printer.

IP ADDRESS: 0.0.0.0 to 255.255.255.255

Set the IP address of the network printer.

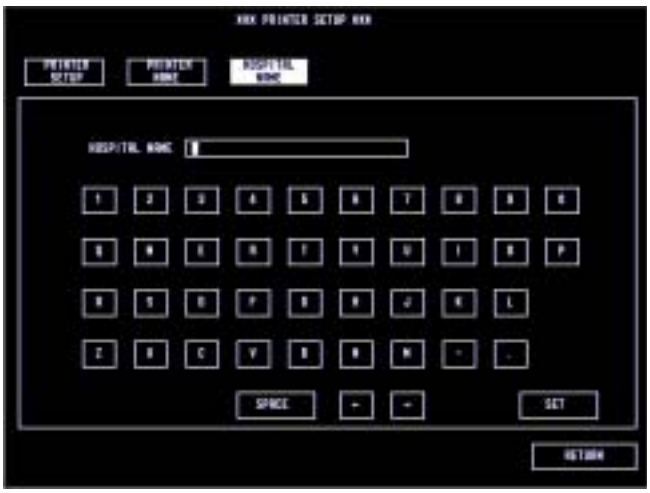
PRINTER NAME

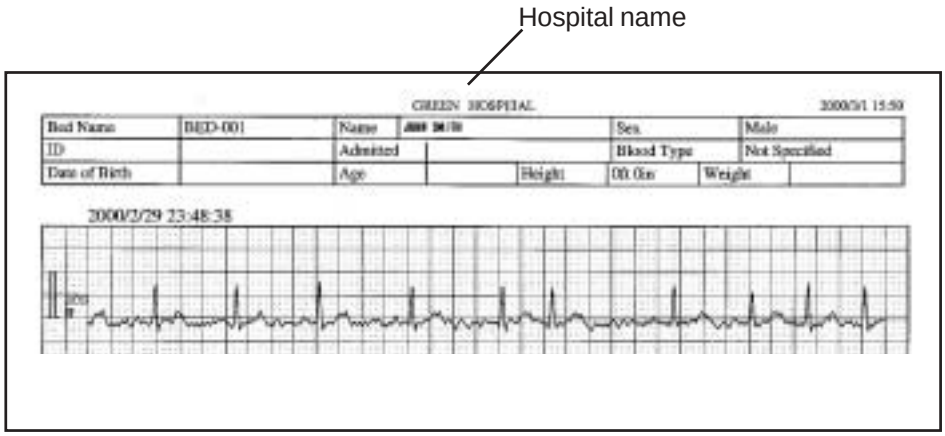
Enter the printer name. Normally, use the default setting “lp”. If data cannot be printed, change the setting to the printer name specified in the printer manual. If the printing still cannot be performed, contact your Nihon Kohden distributor.



HOSPITAL NAME

You can print the hospital or institution name at the top of the printing paper. Up to 32 alphanumerics can be entered.





External Interface Information (EXT I/F SETUP)

When the optional QI-400P series interface is connected to the monitor to connect external display or unit, the RS-232C setting information is displayed on the EXT I/F SETUP screen. The interface can be upgraded on this screen.

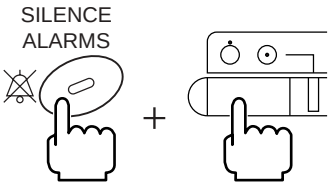
Initializing the System

Usually, this procedure is not performed. Use the following procedure to initialize the instrument to the factory default settings. The factory default settings are listed in “Factory Default Settings” in Section 22.

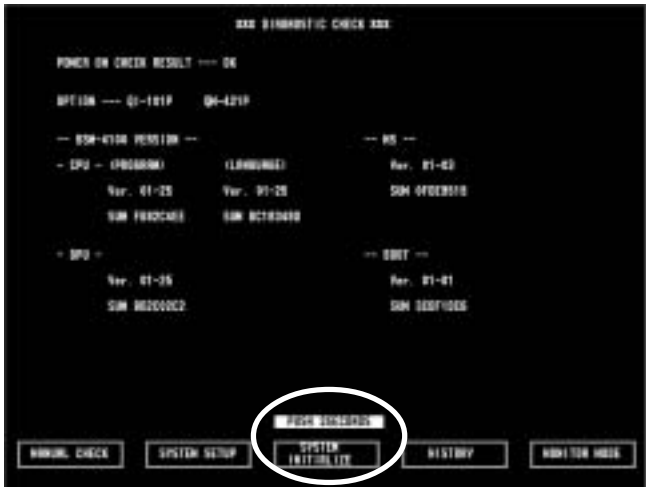
CAUTION

All patient data, stored data and error history are deleted and all settings return to the factory default settings.

1. If turned on, turn off the monitor power.



2. Press the power switch while pressing the SILENCE ALARMS key on the front panel until the DIAGNOSTIC CHECK screen is displayed.



3. Touch and hold the “SYSTEM INITIALIZE” key for 3 seconds until the “PUSH 3 SECONDS” message disappears from the screen.

   When initializing starts, the “SYSTEM INITIALIZE” message appears on the screen and blinks for several seconds.

   When initializing is finished, the message disappears and the DIAGNOSTIC CHECK screen appears.

4. Touch the “MONITOR MODE” key on the DIAGNOSTIC CHECK screen to display the monitoring screen.

Section 4 Necessary Settings Before Monitoring

Changing Date and Time 4.1
Changing Sound Settings 4.3
Changing the Screen Brightness 4.5
Assigning a Function to the Function Keys 4.6
Entering Patient Information 4.8
- Displaying the PATIENT INFO Window 4.8
- Entering the Patient Information 4.9
  - Entering the Patient Name 4.9
  - Entering the Date of Birth and Age 4.11
  - Entering the Height and Weight 4.12
  - Entering the Sex 4.12
  - Entering the Patient ID 4.12

Deleting Data 4.13

Changing Date and Time

When the power is on, the current time is displayed in the upper right corner of the screen.

NOTE

When the date or time is changed during monitoring, the date and time of all stored data is also changed and may not match the date and time on the printout.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “DATE & TIME” key to display the DATE & TIME window.

The DATE & TIME window can also be displayed by touching the time on the upper right corner of the monitoring screen.

3. Touch the “YEAR”, “MONTH”, “DAY”, “HOUR” or “MINUTE” key.

4. Touch the desired number(s).

5. Repeat steps 3 and 4 to enter other items.

6. Touch the “SET” key. The “SET” key must be touched before changing windows. Otherwise the setting changes back to the previous setting.

   When the set date is incorrect, the “OUT OF RANGE” message appears on the screen. Enter the correct date.

7. Press the HOME key on the front panel to return to the monitoring screen.

Changing Sound Settings

On the SOUND & BRIGHT screen, you can select sync sound on or off and adjust the sync sound volume and alarm sound volume.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “SOUND & BRIGHT” key to display the SOUND & BRIGHT window.

3. i) Select “ON” or “OFF” in the SYNC SOUND box to set sync sound on or off.

ii) To change the sync sound volume, touch the desired place on the volume bar in the SYNC SOUND VOLUME box. Touch the ▲ or ▼ key to adjust the setting. At the lowest volume setting, the sync sound is not audible.

iii) To change the alarm sound volume, touch the desired place on the volume bar in the ALARM SOUND VOLUME box. Touch the ▲ or ▼ key to adjust the setting. At the lowest volume setting, the alarm is still audible.

4. After changing settings, press the HOME key on the front panel to return to the monitoring screen.

Changing the Screen Brightness

When operating on battery power, the brightness is automatically set to minimum.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “SOUND & BRIGHT” key to display the SOUND & BRIGHT window.

3. Touch the desired place on the setting bar in the SCREEN BRIGHTNESS box. Use the ▲ or ▼ key to adjust the setting.

4. Press the HOME key on the front panel to return to the monitoring screen.

Assigning a Function to the Function Keys

A function or window can be assigned to each function key on the upper left corner of the screen for changing screens and often used function. When a function is assigned to the function key, that function can be performed or a window can be displayed by just touching the function key at the upper left corner of the screen instead of returning to the monitoring screen or displaying the MENU window. There are three function keys. One of the following functions or windows can be assigned to each key.

- FREEZE
- TOUCHKEY OFF
- ALL ZERO (for IBP monitoring)
- CAL
- PRINT
- MAIN MENU
- HOME
- SLEEP MODE
- BYPASS
- SUSPEND MONITORING
- ENLARGED
- ECG SCROLL
- 12 LEAD
- CO
- INTERBED
- EXTERNAL DEVICE
- TREND
- LIST
- HEMO LIST
- ARRHYTH RECALL
- FULL DISC
- ST
- ALARM HISTORY

It may be useful to assign FREEZE, ALL ZERO or CAL to the function key, because there is no other FREEZE, ALL ZERO or CAL key on any other screen. For the other functions and windows, you can always display these keys on the MENU window.

The BYPASS function key is only available when the site is set to OR on the SYSTEM SETUP screen.

The SUSPEND MONITORING and SLEEP MODE function key is only available when the site is set to either ICU or NICU on the SYSTEM SETUP screen.

The PRINT key is only available when the optional QI-111P printer card is inserted into the monitor.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “FUNCTION KEY” key to display the FUNCTION KEY window.

3. Touch the “FUNCTION KEY 1”, “FUNCTION KEY 2” or “FUNCTION KEY 3” tab to select the function key to which you want to assign a function.

4. Select the function you want to assign to the function key.

5. Repeat steps 3 and 4 to assign a function to another function key.

6. Press the HOME key on the front panel to return to the monitoring screen.

Entering Patient Information

Before entering data for a new patient, you must first delete all the data of a previous patient. Refer to the “Deleting Data” section.

WARNING

When admitting a new patient, check the alarm settings. The alarm settings return to the alarm master settings on the SYSTEM SETUP screen when all data is deleted on the DELETE DATA window or 30 minutes elapse after monitor power off.

CAUTION

When admitting a new patient, first delete all data of the previous patient. Otherwise, the data of the previous patient and new patient will be mixed together. To delete the previous patient data, refer to the “Deleting Data” section.

NOTE

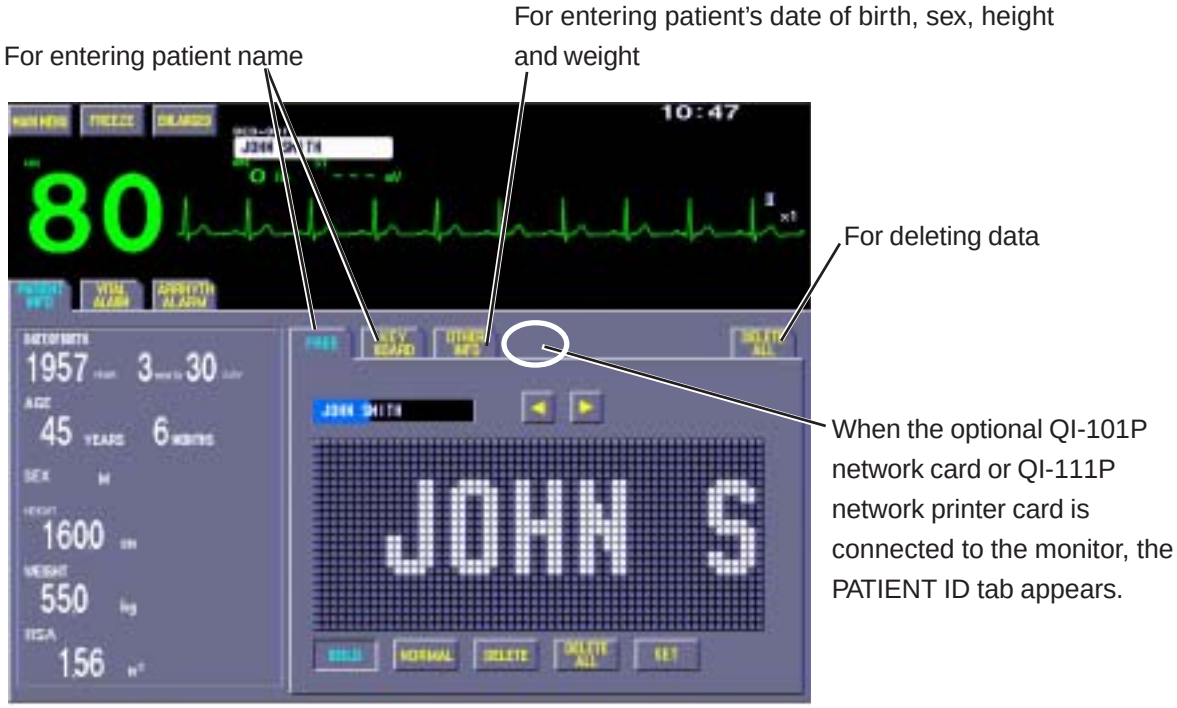
After turning the monitor on and when admitting a patient on the monitor, make sure that the time displayed at the upper right of the screen is correct. When the date or time is changed during monitoring, the date and time of all stored data is also changed and may not match the date and time on the printout.

The height unit (cm or inches) and weight unit (kg or pound) can be set on the SYSTEM SETUP screen. Refer to Section 3.

Displaying the PATIENT INFO Window

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “PATIENT INFO” key to display the PATIENT INFO window.



Entering the Patient Information

Entering the Patient Name

There are two ways to enter the patient name. You can use both ways together.

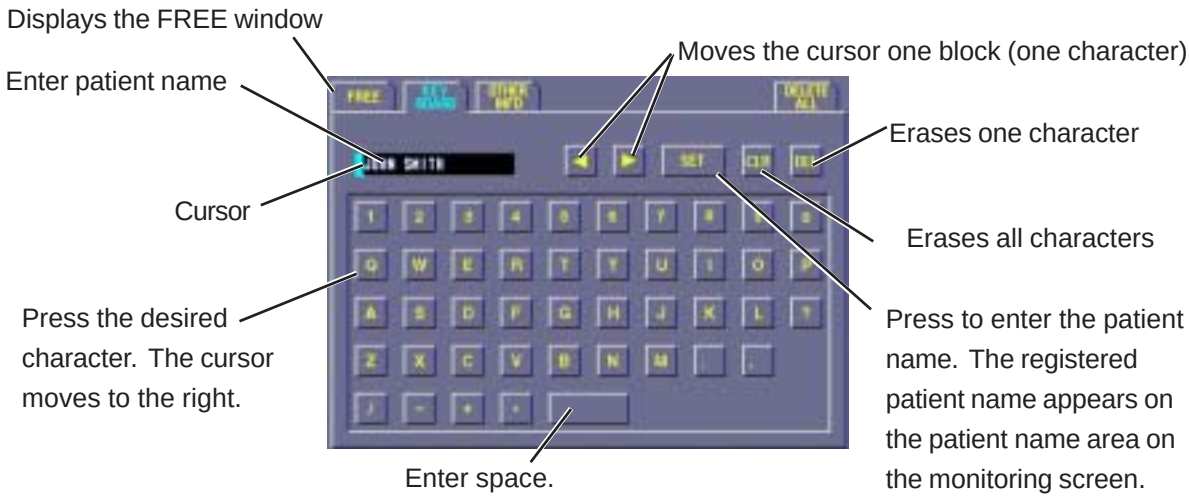
KEYBOARD: Use the keyboard keys displayed on the window. Up to 20 alphanumeric characters can be entered.

FREE: Any character or image you have drawn on the free writing area appears as the patient name.

When the monitor is connected to a central monitor network with an optional QI-101P network card, the FREE window is not available. When the patient name is entered from the FREE window and the monitor is then connected to a network, the patient name on the bedside monitor is deleted and the patient name entered on the central monitor appears on the bedside monitor.

Entering the Patient Name Using the Keyboard

1. Touch the “KEYBOARD” tab. The KEYBOARD window appears.


Displays the FREE window
Enter patient name
Cursor
Press the desired character. The cursor moves to the right.
Moves the cursor one block (one character)
Erases one character
Erases all characters
Press to enter the patient name. The registered patient name appears on the patient name area on the monitoring screen.
Enter space.

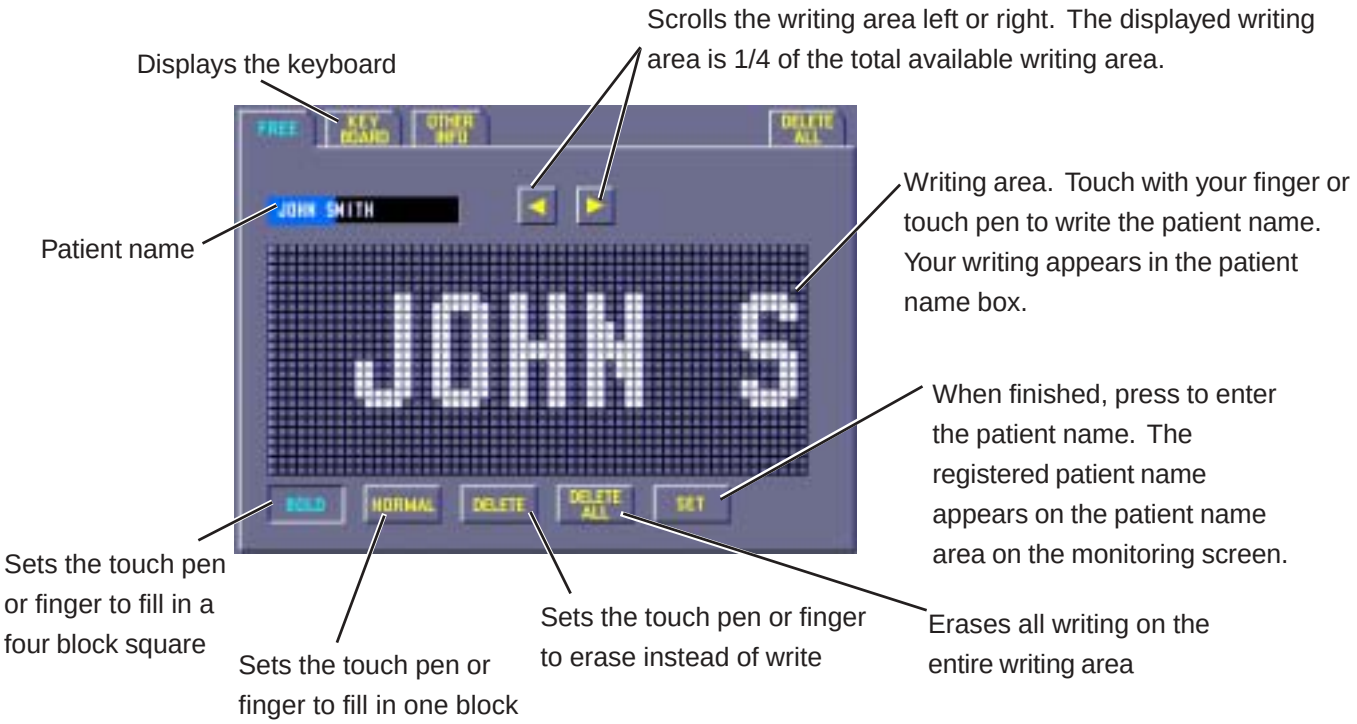
2. Enter the patient name by using the keyboard keys.

3. Touch the “SET” key. The patient name appears in the patient name area on the monitoring screen.

Entering the Patient Name Using Free Function

1. Touch the “FREE” tab. The free writing area appears.

2. Write the patient name with your finger or touch pen in the free writing area.


Displays the keyboard
Scrolls the writing area left or right. The displayed writing area is 1/4 of the total available writing area.
Patient name
Writing area. Touch with your finger or touch pen to write the patient name. Your writing appears in the patient name box.
When finished, press to enter the patient name. The registered patient name appears on the patient name area on the monitoring screen.
Sets the touch pen or finger to fill in a four block square
Sets the touch pen or finger to fill in one block
Sets the touch pen or finger to erase instead of write
Erases all writing on the entire writing area

You can enter any character by drawing it. You can also edit names which were previously entered by keyboard. For example, you can easily make European language characters from English characters.

3. Touch the “SET” key. The patient name appears in the patient name area on the monitoring screen.

Entering the Date of Birth and Age

CAUTION

On the BSM-4103/4104/4113/4114 monitors, when the date of birth or age is not entered, 12 lead ECG interpretation is performed with the patient as 35 years old.

---

1. Touch the “OTHER INFO” tab to display the OTHER INFO window.

2. Touch “YEAR”, “MONTH” or “DAY” key to enter year, month and day respectively.
3. Enter the numbers by using the number keys.
4. Touch the “SET” key. When the year, month and day are entered, age is automatically calculated and appears at the AGE area in the left box.

Entering the Height and Weight

1. Touch the “OTHER INFO” tab to display the OTHER INFO window.
2. Touch “HEIGHT” or “WEIGHT” key to enter height and weight respectively.
3. Enter the numbers by using the number keys.
4. Touch the “SET” key.

Entering the Sex

CAUTION

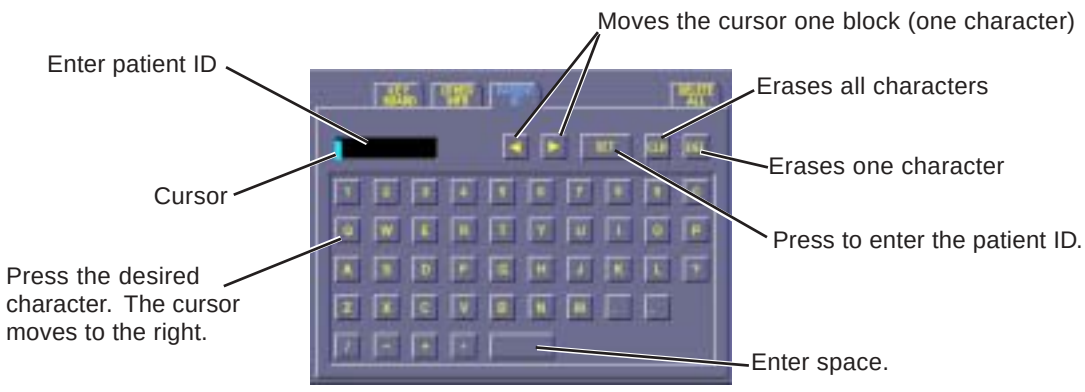
On the BSM-4103/4104/4113/4114 monitors, when the sex is not specified, 12 lead ECG interpretation is performed with the patient as male.

1. Touch the “OTHER INFO” tab to display the OTHER INFO window.
2. Touch “M” for male or “F” for female. Touch “NOT SPECIFIED” when the patient sex is unknown.

Entering the Patient ID

When the QI-101P network card or QI-111P network printer card is connected to the monitor, you can enter a patient ID of up to 16 alphanumeric letters.

1. Touch the “PATIENT ID” tab to display the PATIENT ID window.


Moves the cursor one block (one character)
Enter patient ID
Erases all characters
Erases one character
Cursor
Press to enter the patient ID.
Press the desired character. The cursor moves to the right.
Enter space.

2. Enter the patient ID by using the keyboard keys.
3. Touch the “SET” key.

Deleting Data

When monitoring the patient is no longer required, delete the data. The following data are deleted and the alarm settings return to the alarm master settings.

- Patient information
- Data on the review windows
- Data on the DRUG CALCULATE window (BSM-4103/4104/4113/4114 monitors only)

CAUTION

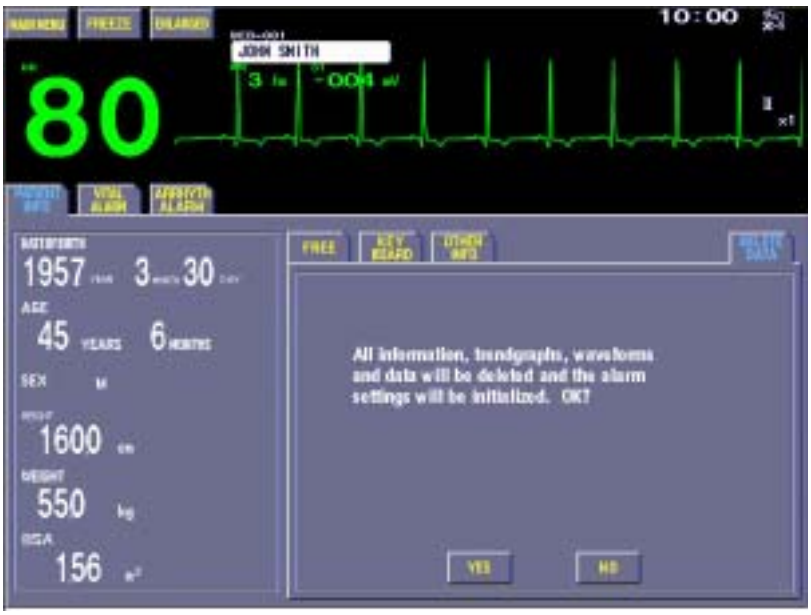
When admitting a new patient, first delete all data of the previous patient. Otherwise, the data of the previous patient and new patient will be mixed together.

You can select whether to suspend monitoring on data deletion on SUSPEND MONITORING ON DATA DELETION on the SYSTEM SETUP screen. Refer to Section 3.

1. Display the PATIENT INFO window by following the procedure in the “Displaying the PATIENT INFO Window” section.

2. Touch the “DELETE DATA” tab. The message confirming the data deletion appears.

When SUSPEND MONITORING ON DATA DELETION on the SYSTEM SETUP screen is set to YES



When SUSPEND MONITORING ON DATA DELETION on the SYSTEM SETUP screen is set to NO

3. Touch the “YES” key to delete data.

   Touch the “NO” key to not delete data.

4. Press the HOME key on the front panel to return to the monitoring screen.

Section 5 Monitoring Screen

Safety Precautions for Monitoring 5.2
Using an Electrosurgery Unit 5.2
Using a Defibrillator 5.2
Overview 5.3
Monitoring Screen 5.3
Review Windows 5.3
Sync Sound 5.4
Adjusting the Sync and Alarm Sound Volume 5.4
Changing Settings and Performing Other Tasks During Monitoring 5.4
Interbed Monitoring 5.4
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Numeric Data Display Over ECG when a Window is Opened 5.6
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Displaying the 12 LEAD Window 5.17
Recording ECG Waveforms on the 12 Lead Window 5.18
Performing 12 Lead ECG Interpretation 5.20

This section explains how to monitor the patient's waveforms and data.

Before monitoring the patient:

- Prepare the patient and equipment according to Sections 2 to 4, 6 and 11 to 19. When using a recorder, also see Section 8.
- Before monitoring a new patient, follow the flowchart in Section 2.
- Read the safety precautions in the "Safety Precautions for Monitoring" section.

In this section:

- "Overview" gives general information for all monitoring.
- "Changing Settings for Monitoring Screen" explains about changing monitoring screen configuration.
- "Displaying OCRG" explains about displaying OCRG.
- "Freezing Waveforms" explains how to freeze waveforms.
- "Calibrating Waveforms" explains how to calibrate waveforms.
- "Using Sleep Mode" explains how to use sleep mode.
- "Displaying Large Numeric Window", "Displaying Cascaded ECG" and "Displaying 12 Lead" explain about displaying large numeric data, cascaded ECG and 12 lead ECG waveforms, respectively.

Safety Precautions for Monitoring

Before beginning monitoring, observe the following safety precautions and the safety precautions in Sections 11 to 19 for ECG and other monitored parameters.

Using an Electrosurgery Unit

WARNING

- **Electrosurgical units (ESU) emit a lot of RF interference. If the monitor is used with an ESU, RF interference may affect the monitor operation.**
- **Locate the monitor as far as possible from the ESU. Locate them on opposite sides of the operating table, if possible.**
- **Connect the monitor and ESU to different AC outlets located as far as possible from each other.**
- **When using this monitor with an electrosurgical unit, its return plate and the electrodes for monitoring must be firmly attached to the patient. If the return plate is not attached correctly, it may burn the patient's skin where the electrodes are attached.**

Using a Defibrillator

WARNING

To avoid the risk of serious electrical burn, shock, or other injury during defibrillation, all persons must keep clear of the bed and must not touch the patient or any equipment connected to the patient.

If the ECG waveform on the screen is too unstable to synchronize with the patient's heart beat because of the following reason(s), remove the cause(s) of an alarm, message, or unstable ECG, and then use a stable ECG lead for synchronization.

- ECG electrode is detached or broken. Lead wire is detached or broken.
- Lead wire moves. AC interference, EMG noise or noise from ESU is superimposed.
- Connection cable is broken or has a short circuit. Connector has poor contact.

Overview

Monitoring Screen

When you first begin monitoring, a monitoring screen appears. The monitoring screen displays waveforms and numeric data for ECG and other parameters. Any time you press the HOME key on the front panel, the monitoring screen appears.

The parameters on the monitoring screen depend on the measured parameter.

When the monitor power is turned on, the monitor enters “standby mode” while the monitor is waiting for the electrodes and probe to be attached to the patient. “CHECK ELECTRODES”, “NO PULSE” and “CHECK PROBE” alarms will not be activated. “CHECK PROBE SITE” and “PULSE SEARCH” messages will not be displayed. The ECG or SpO_2 monitoring starts when the connection cord is connected to the socket on the monitor and electrodes or probe is attached to the patient.

NOTE

If the monitor power is turned off and on again within 10 seconds, the monitor skips standby mode.

Review Windows

NOTE

The stored data remains in memory for about 30 minutes after the power is turned off. After 30 minutes, the stored data is lost.

The trend, list, hemodynamics, arrhythmia recall, full disclosure, ST level recall and alarm history windows display the stored data. You can display trendgraphs of the past 1 to 24 hours on the trend window, the list of vital signs data on the list window, hemodynamics data of up to 8 files from CO monitoring on the hemodynamics list window, arrhythmia recall files of up to 16 files (up to 100 files with the optional QM-421P flash disk card) on the arrhythmia recall window and alarm data of up to 200 files on the alarm history window. The full disclosure and ST level recall windows are available when the optional QM-421P flash disk card is installed in the monitor. Up to 48 hours of compressed ECG can be stored for the full disclosure and up to 500 files for the ST level recall.

There are two types of lists for the list window: periodic vital signs list and NIBP list (vital signs list with NIBP measurements). Up to 120 measurements can be stored for each type.

For details about the review windows, refer to Section 7.

Sync Sound

During monitoring, a continuous “pip” sounds in synchronization with either the QRS or pulse waveform. QRS is the default setting. Refer to “Changing the Sync Source” in Section 11, 13 or 15 to change the source of the sync sound.

Adjusting the Sync and Alarm Sound Volume

The sync sound volume and alarm sound volume can be adjusted on the SOUND & BRIGHT window. At the lowest setting, the alarm sound is audible but the sync sound is not audible. Refer to “Changing Sound Settings” in Section 4.

Changing Settings and Performing Other Tasks During Monitoring

Every screen except the SYSTEM SETUP screen always displays at least one real-time ECG waveform and heart rate. This lets you monitor the patient continuously without interruption while you do other tasks, such as changing settings, printing reports, or viewing trendgraphs.

The screen returns to the monitoring screen when there is no key operation for about 3 minutes.

Interbed Monitoring

When the bedside monitor is connected to a central monitor, the bedside monitor data can be sent to the central monitor. Up to 8 beds in the network can be registered as “interbed” beds and monitoring data of the selected interbed bed can be displayed on the INTERBED window. When an alarm occurs at an interbed bed, the “ALARM bed name” message appears on the screen. The interbed alarm can also be suspended from this bedside monitor. Refer to Section 10.

To connect the bedside monitor to the central monitor network, the optional QI-101P network card is required.

Monitoring Screen

When you first begin monitoring, a monitoring screen appears.

The monitoring screen is automatically laid out according to the measured parameters. The layout changes when a measuring parameter changes.

ECG waveform is cascaded on the monitoring screen when there is no IBP monitoring.

The settings for monitoring parameters can be changed individually on the parameter window. For details about individual parameters, see Sections 11 to 19.

The respiration rate can only be detected from one parameter. When CO_2 and respiration are monitored at the same time, the respiration rate is detected in the following priority.
CO_2 > thermistor method respiration > impedance method respiration

The latest 30 minute parameter data can be displayed as trendgraph on the monitoring screen. This trendgraph can be dragged by touching the right edge of the trendgraph and moving it right or left.

An OCRG can be displayed on the monitoring screen instead of a trendgraph. Refer to the “Displaying OCRG” section.

Settings for the Monitoring Screen

Waveform Sweep Mode and Speed

The waveform displaying mode (fixed or moving) on the monitoring screen can be set at WAVE DISPLAY on the SYSTEM SETUP screen. Refer to Section 3.

The sweep speed of waveforms other than respiration/CO_2 waveform on the monitoring screen can be selected from 25 or 50 mm/s at SWEEP SPEED on the DISPLAY window.

The respiration and CO_2 waveform sweep speed on the monitoring screen can be selected from one of three speeds: 1, 6, or 25 or 50 mm/s at RESP/CO_2 SWEEP SPEED on the DISPLAY or RESP/CO_2 window. The third selectable speed in RESP/CO_2 SWEEP SPEED is the setting in SWEEP SPEED on the DISPLAY window. (25 or 50 mm/s)

The sweep speed of the gas waveforms in anesthesia monitoring is fixed at 6 mm/s.

Trendgraph/OCRG Display on the Monitoring Screen On or Off

The trendgraph/OCRG display on the monitoring screen is set on the TREND ON MONITORING SCREEN setting on the DISPLAY window. Refer to the “Changing Settings for Monitoring Screen” section.

NORMAL:	Trendgraph display on the monitoring screen
OCRG 1 cm/min:	OCRG display with the horizontal scale 1 cm/min
OCRG 3 cm/min:	OCRG display with the horizontal scale 3 cm/min
OFF:	No trendgraph/OCRG display on the monitoring screen

Numeric Data Display Over ECG when a Window is Opened

The numeric data of the monitoring parameters can be displayed over an ECG when a window is opened when NUMERIC DISPLAY OVER ECG on the DISPLAY window is set to ON. Refer to the “Changing Settings for Monitoring Screen” section.

Blood Pressure Waveform Display Mode

There are two ways of displaying blood pressure waveforms. This can be changed on the PRESS SCALE on the PRESS or DISPLAY window.

SEPARATE:	Blood pressure waveforms are displayed separately on different scales.
COMMON:	Blood pressure waveforms are displayed on the same scale.

Background and Parameter Colors

The background color of the monitoring screen can be set to either black or white on BACKGROUND on the SYSTEM SETUP screen. Refer to Section 3.

The parameter colors are set on the PARAMETER COLOR on the SYSTEM SETUP screen. Refer to Section 3.

Waveform Sensitivity

Waveform sensitivity can be changed on the parameter window. Refer to Sections 11 to 19.

Displaying Other Windows from the Monitoring Screen

Touching the following items on the monitoring screen displays the following windows.

- Numeric value ..... Parameter setting window
- Patient name ..... PATIENT INFO window
- Time ..... DATE & TIME window
- Function key ..... Window assigned to the function key

Changing Settings for Monitoring Screen

The following items can be set for the monitoring screen configuration.

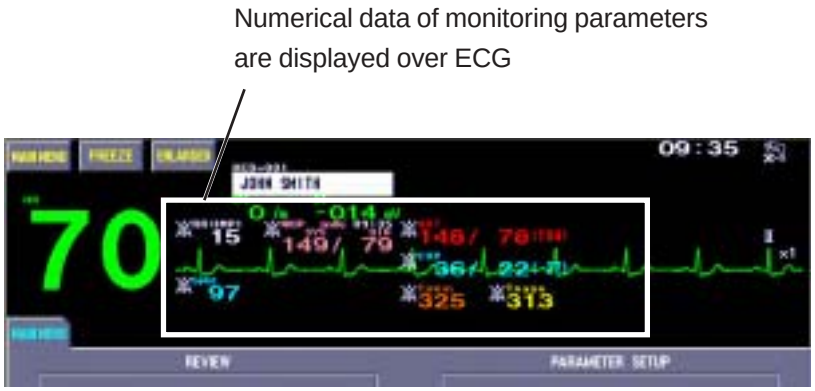
- Trendgraph/OCRG display on or off
- Numeric data display over ECG when a window is opened
- Blood pressure waveform display mode
- Respiration/CO_2 waveform sweep speed
- Waveform sweep speed (except for respiration/CO_2 waveform)

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “DISPLAY” key to open the DISPLAY window.

3. To change the trendgraph/OCRG display, select one of the following.
   NORMAL: Trendgraph display on the monitoring screen
   OCRG 1 cm/min: OCRG display with the horizontal scale 1 cm/min
   OCRG 3 cm/min: OCRG display with the horizontal scale 3 cm/min
   OFF: No trendgraph/OCRG display on the monitoring screen

   To display numerical data of the monitoring parameters when a window is opened, select “ON” in the NUMERIC DISPLAY OVER ECG box.



   To change the blood pressure waveform display mode, select SEPARATE or COMMON in the PRESS SCALE box.
   SEPARATE: Blood pressure waveforms are displayed separately on different scales.
   COMMON: Blood pressure waveforms are displayed on the same scale.

   To change the respiration/CO_2 waveform sweep speed, select from one of three speeds: 1, 6, or 25 or 50 mm/s in the RESP/CO_2 SWEEP SPEED box. The third selectable speed in RESP/CO_2 SWEEP SPEED is the setting in SWEEP SPEED on the DISPLAY window. (25 or 50 mm/s) When anesthetic gas is monitored, the gas waveform sweep speed is fixed at 6 mm/s.

   To change the sweep speed of waveforms other than respiration/CO_2 waveform, select from 25 or 50 mm/s in the SWEEP SPEED box.

4. Press the HOME key on the front panel to return to the monitoring screen.

Displaying OCRG

The OCRG (oxygen-cardio-respirogram) can be displayed on the monitoring screen instead of a trendgraph.

On the OCRG, only HR, SpO_2 and respiration rate trendgraphs and compressed respiration waveform are displayed. When other parameter is monitored, only the numeric data and waveform for that parameter are displayed on the monitoring screen.

To record OCRG, set PERIODIC REC INTERVAL (min) on the RECORDING window to 5(OCRG) or 15(OCRG). Refer to “Setting Periodic Recording” in Section 8.

To display OCRG on the monitoring screen, set TREND DISPLAY ON MONITORING SCREEN to either OCRG 1 cm/min or OCRG 3 cm/min on the DISPLAY window. Refer to the “Changing Settings for Monitoring Screen” section.

OCRG 1 cm/min

OCRG 3 cm/min

Freezing Waveforms

Normally, the waveforms continuously sweep across the screen. You can also "freeze" (stop sweeping) the waveforms. By freezing the waveforms, you can observe one part of a waveform in detail. The numerical data on the screen are not frozen.

To freeze waveforms, the freeze function must be assigned to one of the function keys in the upper left corner of the screen. Refer to "Assigning a Function to the Function Keys" in Section 4.

When the freeze function is assigned to a function key, waveforms on the monitoring screen can be frozen any time by touching the "FREEZE" key. The waveforms are frozen for 3 minutes or until they are unfrozen.

When the waveforms are frozen, the "FREEZE" message appears with the frozen time.

To unfreeze the waveforms,

- touch any key on the screen,
- press any key on the front panel, or
- turn either function dial

Calibrating Waveforms

To check accuracy, you can display a calibrated ECG and blood pressure waveforms and 37° C temperature. During calibration, the calibrated waveforms are displayed. Visually verify that they are correct.

To perform calibration, the calibration function must be assigned to one of the function keys in the upper left corner of the screen. Refer to “Assigning a Function to the Function Keys” in Section 4.

When the calibration function is assigned to a function key, calibration is performed any time by touching the “CAL” key. The “CALIBRATING” message appears on the screen.

Using Sleep Mode

In sleep mode, the screen is darkened and sync sound is turned off. The sleep mode is available only when the site mode is set to ICU or NICU. To change the site mode, refer to Section 3.

Use this mode when you want to prevent the monitor from disturbing the patient, such as during sleep.

When EXIT SLEEP MODE ON ALARM on the SYSTEM SETUP screen is set to:
YES: Sleep mode is turned off and the monitoring screen appears when an alarm occurs.
NO: Sleep mode continues even when an alarm occurs.
Refer to Section 3.

WARNING

When EXIT SLEEP MODE ON ALARM is set NO, the bedside monitor alarm cannot be seen or heard on the bedside monitor during sleep mode. Monitor the bedside monitor alarm on the central monitor or telemetry system. Otherwise, the bedside monitor alarm may be overlooked.

Turning Sleep Mode On

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “SLEEP MODE” key. The message appears to confirm if the sleep mode should be set.

When EXIT SLEEP MODE ON ALARM on the SYSTEM SETUP screen is set to YES

When EXIT SLEEP MODE ON ALARM on the SYSTEM SETUP screen is set to NO

3. Select “YES” to set the sleep mode.

   Select “NO” to cancel setting the sleep mode.

During the sleep mode, the following screen is displayed.

When EXIT SLEEP MODE ON ALARM on the SYSTEM SETUP screen is set to YES

When EXIT SLEEP MODE ON ALARM on the SYSTEM SETUP screen is set to NO

Turning Sleep Mode Off

Touch the screen, press any hard key or turn either of the function dials.

When the sleep mode is turned off by pressing a hard key, the function of that hard key is also performed. For example, if the ◇/▽ NIBP START/STOP key is pressed, NIBP measurement in manual mode is performed.

Displaying the Large Numeric Window

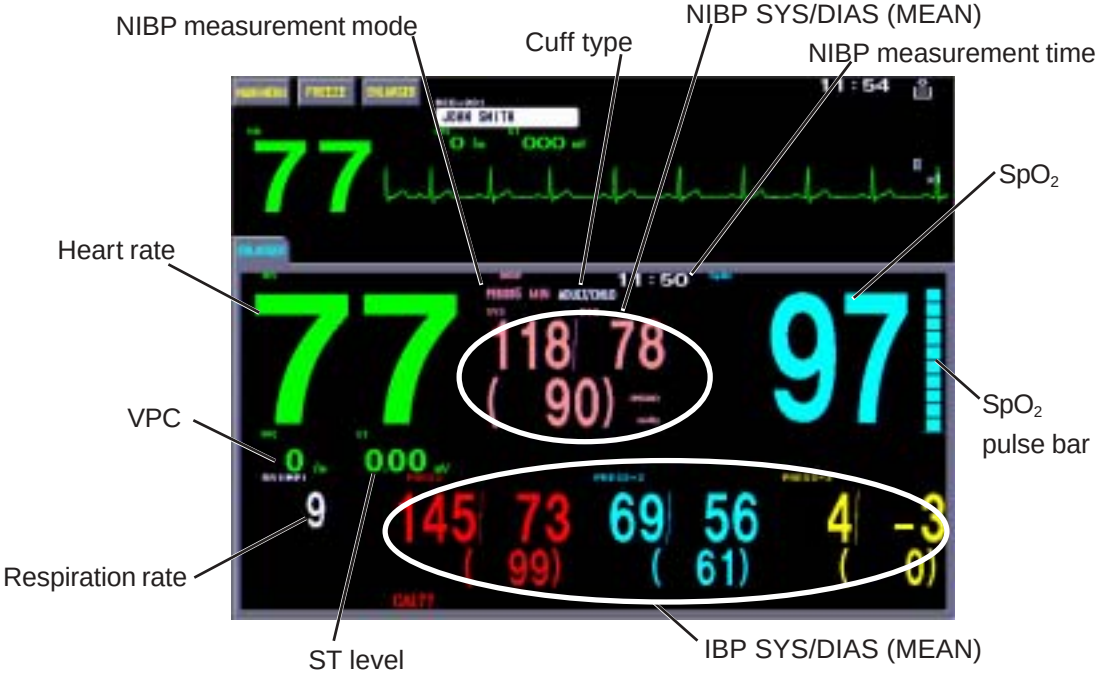
The numeric data of all monitoring parameters are enlarged on the ENLARGED window. This window is useful for viewing at a distance.

When respiration by impedance method, respiration by thermistor method and CO_2 are monitored at the same time, the respiration rate data on the ENLARGED window is detected in the following priority.

CO_2, respiration by thermistor, respiration by impedance

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “ENLARGED” key. The ENLARGED window appears.



3. Press the HOME key on the front panel to return to the monitoring screen.

Displaying Cascaded ECG Window

On the ECG SCROLL window, the latest 48 s ECG can be displayed cascaded. The waveform is refreshed every 8 s.

To display the CASCADED ECG Window:

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “ECG SCROLL” key. The ECG SCROLL window appears.

3. Press the HOME key on the front panel to return to the monitoring screen.

12 Lead ECG Window

The 12 LEAD window is available only for the BSM-4103/4104/4113/4114 monitors.

When ECG is monitored with 10 electrodes, simultaneous 12 lead ECG can be displayed on the 12 LEAD window. When ECG is monitored with 6 electrodes, simultaneous 8 lead ECG can be displayed.

The ECG waveforms on the 12 LEAD window can be analyzed by the 12 lead ECG interpretation program (ECAPS 12C) and analysis result and clinical findings can be displayed on the screen. For details about the analysis and the clinical findings, refer to the ECAPS 12C program user's guide.

ECG waveforms displayed on the 12 LEAD window and the 12 lead ECG interpretation result can be recorded (BSM-4103/4104 monitors only).

When the monitor is connected to the CNS-9300 series or CNS-9701 central monitor network with the optional QI-101P network card, the ECG waveforms displayed on the 12 LEAD window, the 12 lead ECG interpretation result and the averaged ECG can be printed on the central monitor printer.

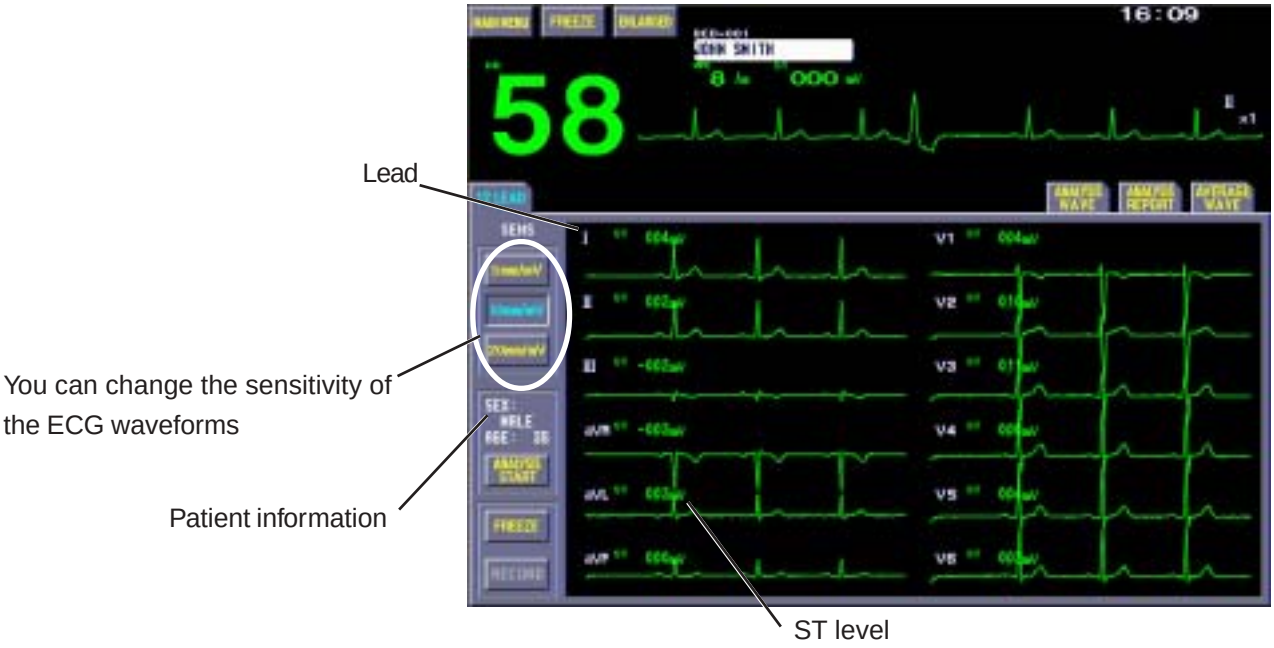
When the monitor is connected to the CNS-9701 central monitor with QP-974P program kit, the 12 lead ECG interpretation result and ECG waveforms are automatically sent to the central monitor and can be reviewed and printed on the central monitor.

When the monitor is connected to a network printer with the optional QI-111P network printer card, the ECG waveforms displayed on the 12 LEAD window, the 12 lead ECG interpretation result and the averaged ECG can be printed on the network printer.

Displaying the 12 LEAD Window

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “12 LEAD” key. The 12 LEAD window appears.



3. Touch the HOME key on the front panel to return to the monitoring screen.

Recording ECG Waveforms on the 12 Lead Window

1. Freeze the waveforms by touching the “FREEZE” key on the 12 LEAD window.

2. Touch the “RECORD” key. 10 second ECG of all leads are recorded.

Recording example

Performing 12 Lead ECG Interpretation

CAUTION

- **The 12 lead ECG interpretation is performed for acquired ECG waveforms only and does not reflect all conditions of the patient. The results of the analysis may not correspond to the judgement of a physician.**
- **Overall judgement must be performed by the physician, referring to the analysis result, clinical findings and other examination results. After the physician's overall judgement, the analysis results should be signed or initialed by the physician.**
- **When the patient sex is not specified, the analysis is performed with the patient as male.**
- **When the patient's date of birth or age is not entered, the analysis is performed with the patient as 35 years old.**

NOTE

- **When electrodes are not attached to the limbs, the analysis result concerning the ECG axis (such as axis deviation) may differ from the analysis with electrodes attached to limbs.**
- **Noise is rejected from the analyzed waveforms by the 50/60 Hz filter, but noise other than these frequencies might not be rejected.**

1. Touch the "ANALYSIS START" key on the 12 LEAD window. The "STORAGE IN PROGRESS. PLEASE WAIT" message appears and 10 second ECG is stored for the analysis.

   To cancel analyzing ECG, touch the "ANALYSIS STOP" key.

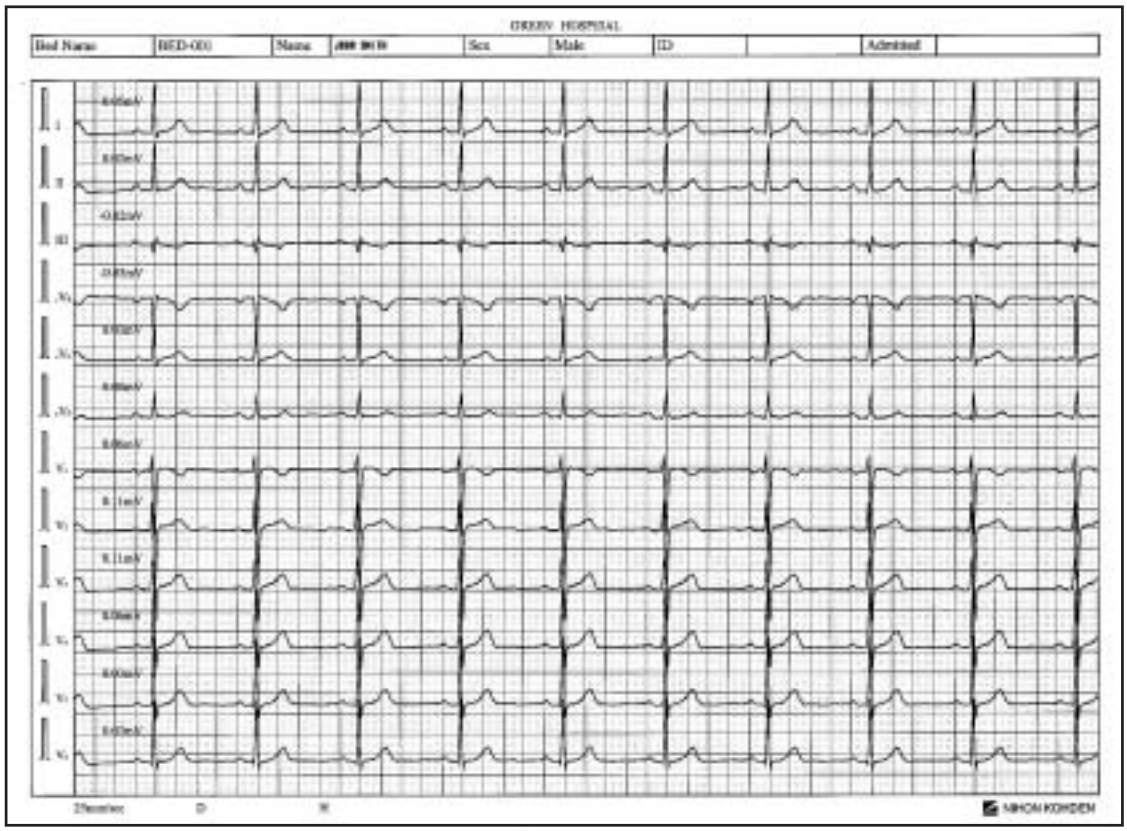
   Then, the "PLEASE WAIT" message appears, the analysis starts and the ANALYSIS WAVE window is displayed. The analysis takes about 30 to 50 seconds.

When the “ANALYZING. PLEASE WAIT” message disappears, the analysis is complete. About 2.5 seconds of ECG of each lead and 10 seconds of rhythm waveform (lead II) used for the analysis are displayed.

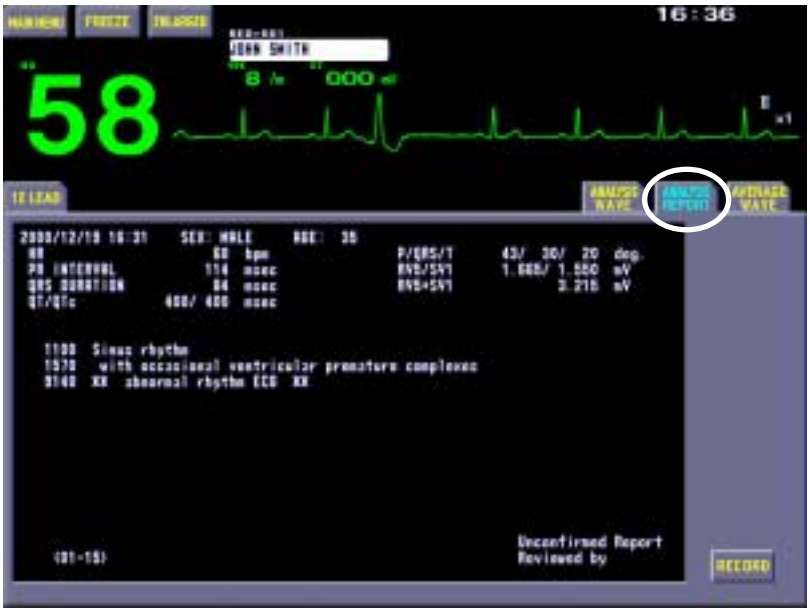
To record these ECG waveforms, touch the “RECORD” key. 10 second ECG waveforms are recorded. The rhythm waveform is not recorded.

To print 10 second 12 lead ECG waveforms when the monitor is connected to a network printer with the QI-111P network printer card, or the monitor is connected to a CNS-9300 series or CNS-9701 central monitor network with the QI-101P network card, touch the “PRINT START” key on the ANALYSIS WAVE window.

Printing Example



2. Touch the “ANALYSIS REPORT” tab to display the analysis result. For details about the findings, refer to the ECAPS 12C program user’s guide.



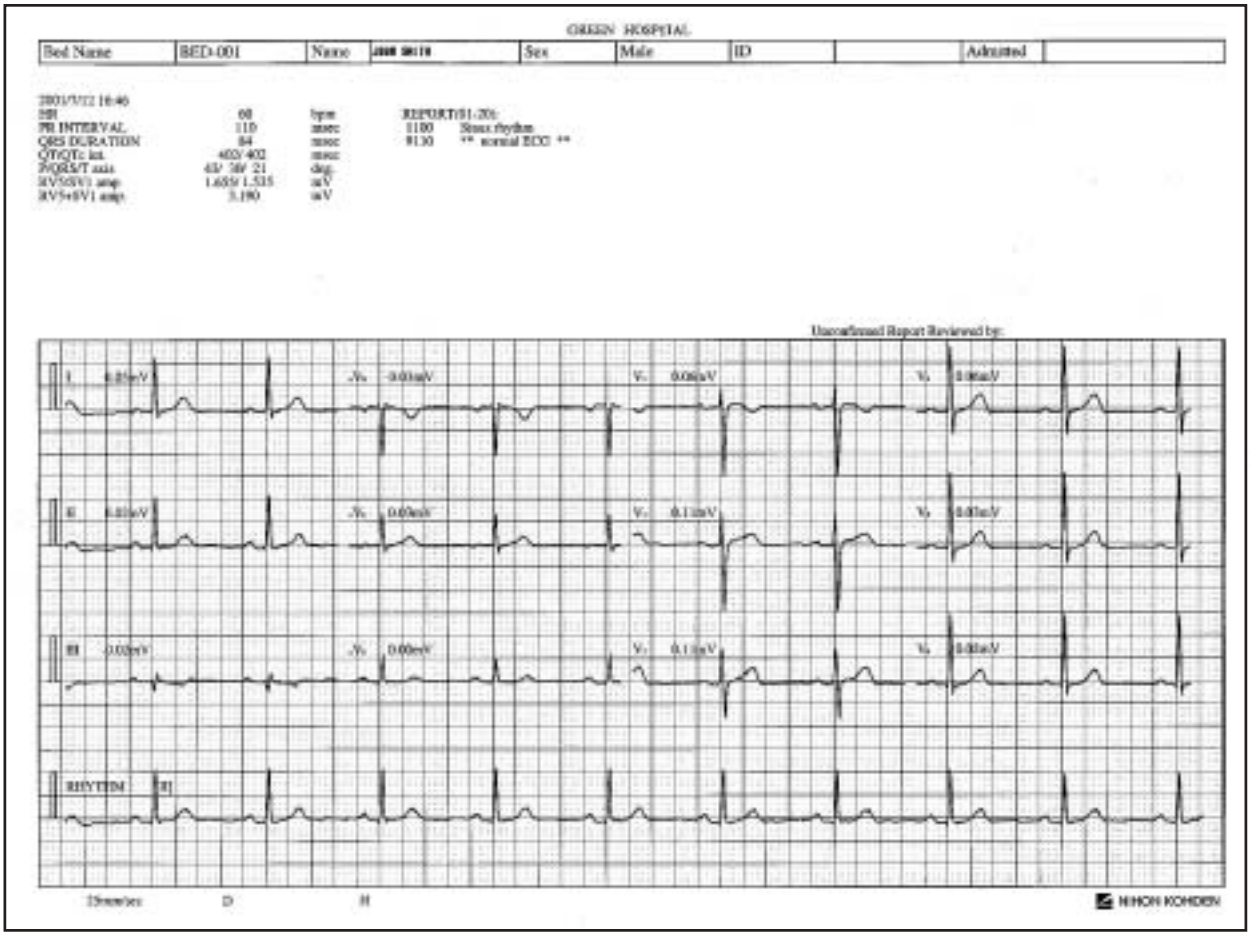
When the analysis is not performed, the “NO DATA” message appears.

To record the analysis result on the screen, touch the “RECORD” key.

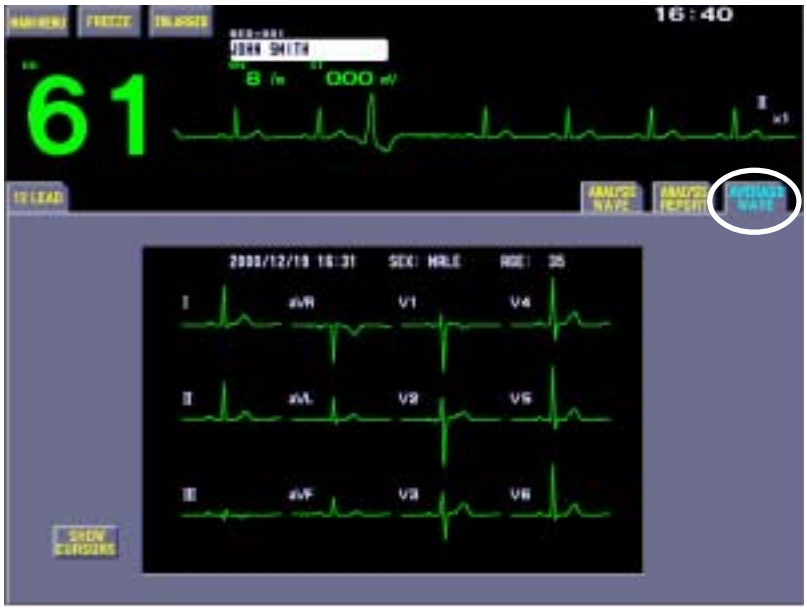
Recording example

To print analysis result and 4 second 12 lead ECG waveforms with 10 second rhythm waveform when the monitor is connected to a network printer with the QI-111P network printer card, or the monitor is connected to a CNS-9300 series or CNS-9701 central monitor network with the QI-101P network card, touch the “PRINT START” key on the ANALYSIS REPORT window.

Printing Example



3. Touch the “AVERAGE WAVE” tab to display the averaged QRS wave of each lead.

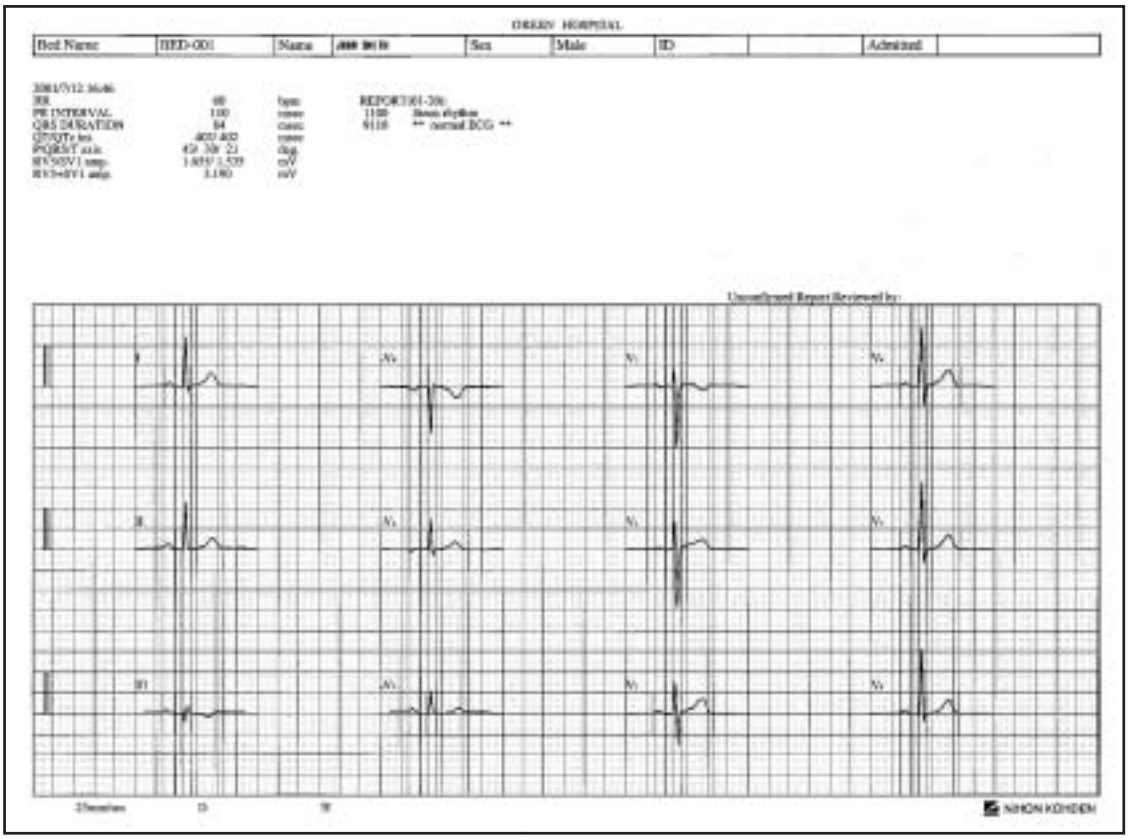


When the analysis is not performed, the “NO DATA” message appears.

4. Touch the “SHOW CURSORS” key on the AVERAGE WAVE window to display cursors on the waveforms. The cursors appear at the start of P wave, end of P wave, start of QRS wave, end of QRS wave and the end of T wave for each lead.

To print averaged waveforms on the AVERAGE WAVE window when the monitor is connected to a network printer with the QI-111P network printer card, or the monitor is connected to a CNS-9300 series or CNS-9701 central monitor network with the QI-101P network card, touch the “PRINT START” key on the AVERAGE WAVE window. The analysis report is also printed.

Printing Example



5. When the analysis result on the ANALYSIS REPORT window is recorded or printed in step 2, the recorded/printed data must be examined by a physician. After the physician's overall judgement, the "Unconfirmed Report" message on the recording/printing paper must be crossed out and signed by the physician.

When another analysis is performed, the previous data is deleted. If necessary, record or print the analysis result before performing another analysis.

Section 6 Alarm Function

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This section explains:

- An overview of alarms.
- Alarm types.
- Alarm indications.
- Suspending an alarm. When an alarm occurs, you can temporarily turn off the alarm indications. This feature is useful if you are already attending to the patient and don’t need the alarm.
- Setting individual alarms, turning automatic alarm recording on or off and all other functions for alarms.

Overview of Alarms

What is an Alarm

When the monitor detects an abnormal patient condition, it can generate an alarm sound, screen indication, and alarm lamp indication. You can set each individual alarm condition. There are four types of alarms: vital signs, arrhythmias, parameter and other alarms, and three levels of alarm: crisis, warning and advisory. The different alarm types are fully explained in the “Alarm Types” section and different alarm levels are explained in the “Alarm Indications” section.

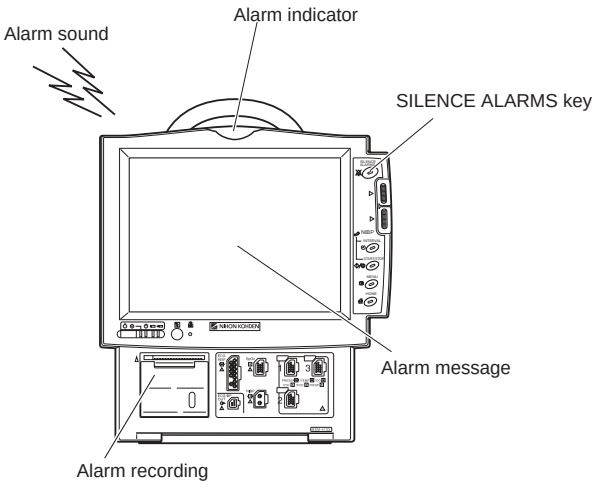
WARNING

When admitting a new patient, check the alarm settings. The alarm settings return to the alarm master settings on the SYSTEM SETUP screen when all data is deleted on the DELETE ALL window or 30 minutes elapse after monitor power off.

NOTE

When the monitor is in STANDBY MODE,

- **“CHECK ELECTRODES”, “NO PULSE” and “CHECK PROBE” alarms will not be activated.**
- **“CHECK PROBE SITE” and “PULSE SEARCH” messages will not be displayed.**



Alarm Level

There are three alarm levels.

CRISIS: Patient is in a critical condition and patient life may be at risk. Immediate action must be taken. Electrodes or probe off, or incorrect lead or other cable connections may also cause this alarm.

WARNING: Patient is in a critical condition. Prompt action should be taken. Electrodes or probe off, or incorrect lead or other cable connections may also cause this alarm.

ADVISORY: Electrodes, probe, cuff, lead and other cable connections or settings on the monitor are not appropriate for accurate measurement. Prompt action should be taken.

Alarm Priority

When several alarms occur at the same time, the alarm with the highest alarm level is indicated. The heart rate (pulse rate) alarm is always displayed regardless of the alarm level.

Silencing an Alarm

You can temporarily silence current alarm sounds and indications, except for an interbed alarm, for a 1 or 2 minute period. See the “Temporarily Silencing/ Suspending Alarms” section. The interbed alarm can only be suspended on the alarmed bed.

All alarms can also be suspended before they occur. This monitor has two types of alarm suspension:

- Suspending all alarms for two minutes. For example: for electrode replacement, etc.
- Suspending all alarms indefinitely. For example: when the patient is connected to a heart-lung machine or being examined.

WARNING

During alarm suspension, all current alarms are temporarily turned off.

Alarm Master

For fast and easy alarm setup, a group of alarm items can be set all together at one time. For example, there may be typical alarm settings at your hospital, or you may have certain alarm settings for certain patients. There is one alarm master for vital signs and one alarm master for arrhythmias.

Even when alarms are set by an alarm master, individual alarm settings can still be changed on the VITAL ALARM and ARRHYTH ALARM windows or the alarm setting window of each parameter window. See the “Setting Alarm” section.

Automatic Recording

On the BSM-4101/4102/4103/4104 bedside monitors, you can set the monitor to automatically record ECG waveforms and data when an alarm occurs. See the “Turning Automatic Alarm Recording On/Off” section.

If a higher level alarm occurs during another alarm recording, the present alarm recording is cancelled and the higher level alarm is recorded.

From the bedside monitor, the alarm recording cannot be recorded on the recorder of the connected central monitor. For the BSM-4111/4112/4113/4114 bedside monitors, waveforms and data can only be recorded manually on the central monitor recorder.

Alarm Setting

Usually, alarms are set before monitoring, but alarms can be set or changed anytime without interrupting monitoring.

If you turn the bedside monitor power switch off, all alarm settings return to the alarm master settings of the SYSTEM SETUP screen 30 minutes later.

To set a parameter alarm to off, set the upper and lower limits to OFF.

Adjusting Alarm Sound Volume

The alarm sound volume can be adjusted on the SOUND & BRIGHT window. Refer to “Changing Sound Settings” in Section 4.

Standby Mode

When the monitor power is turned on, it enters “standby mode” while the monitor is waiting for the electrodes and probe to be attached to the patient. “CHECK ELECTRODES”, “NO PULSE” and “CHECK PROBE” alarms will not be activated. “CHECK PROBE SITE” and “PULSE SEARCH” messages will not be displayed. The ECG or SpO_2 monitoring starts when the connection cord is connected to the socket on the monitor and electrodes or probe is attached to the patient.

CAUTION

During standby mode, the parameter alarms do not function and only the following message is displayed on the screen.

Parameter	Displayed Message	Instead of
ECG	ATTACH ELECTRODES	CHECK ELECTRODES
SpO_2	ATTACH PROBE	CHECK PROBE PULSE SEARCH NO PULSE CHECK PROBE SITE

Site Mode and Stage

The site mode is set on the SYSTEM SETUP screen. Refer to Section 3.

When the site mode is OR, the “BYPASS” key is displayed on the MENU window. When the site mode is ICU or NICU, the “SUSPEND MONITORING” key is displayed on the MENU window. When the “BYPASS” or “SUSPEND MONITORING” key is pressed, all alarms are turned off. Use these keys when you want to suspend alarms during bypass operation or when the patient is undergoing a test such as an X-ray. All alarms are suspended until the “BYPASS” or “SUSPEND MONITORING” key is pressed again.

In ICU or NICU mode, alarms resume and the “SUSPEND MONITORING” key returns to the off position when heart rate, SpO_2, IBP, CNIBP or $EtCO_2$ (except $EtCO_2$ measured by AG-920RA multigas unit) is monitored properly for the time length set on the SUSPEND ALARM TIME on the SYSTEM SETUP screen or when NIBP is measured. For the time length setting, refer to Section 3.

Alarm History Window

The date and time, type of parameter and alarm message is saved as a file on a vital sign or arrhythmia alarm occurrence. These data can be viewed on the ALARM HISTORY window. Refer to “Alarm History Window” in Section 7.

Interbed Alarm

The bedside monitor can display monitoring data of up to 8 other beds in the network on the INTERBED window. To do this you must register the other beds as “interbed” beds. When an alarm occurs at an interbed bed, the alarm message appears on the INTERBED window or the “ALARM bed name” message appears on the monitoring screen. The interbed alarm can also be silenced from this bedside monitor. The interbed alarm on or off and automatic INTERBED window display on an interbed alarm occurrence can be set on the SETTING window of the INTERBED window. Refer to Section 10.

Alarm Types

Alarms are divided into 4 categories: vital signs, arrhythmia, parameter and other alarms. The alarm name is displayed on the screen when an alarm occurs. For the vital signs and arrhythmia alarms, waveforms and data can be recorded on the BSM-4101/4102/4103/4104 monitors in automatic alarm recording.

For the alarm types which are not classified into alarm levels, only the message is displayed.

Vital Signs Alarms

Alarm Name	Description
Heart rate (numeric data)	High/low limit exceeded
ST ALARM	High/low limit exceeded
SpO_2 ALARM	High/low limit exceeded
NIBP ALARM	High/low limit exceeded (systolic/diastolic mean)
PR (pulse rate) ALARM	High/low limit exceeded
APNEA ALARM	Limit exceeded
P1/P2/P3 ALARM	High/low limit exceeded
TEMP ALARM	High/low limit exceeded
RR (respiration rate) ALARM	High/low limit exceeded
CO_2 ALARM	High/low limit exceeded
FiO_2 ALARM	High/low limit exceeded

Arrhythmia Alarms

Arrhythmia name	Description
ASYSTOLE	Longer than 3 to 10 seconds (selectable) with no QRS complex.
VF	Ventricular fibrillation.
VT	Ventricular tachycardia. 9 or more consecutive VPCs.
VPC RUN	VPC short run. 3 to 8 (selectable) consecutive VPCs.
COUPLET	VPC couplet (paired VPCs). 2 consecutive VPCs.
EARLY VPC	Early VPC. VPC with a time interval from the preceding normal QRS complex of less than approx. one-third of the normal R-R interval.
BIGEMINY	Ventricular bigeminy. 3 or more consecutive pairs of VPC and normal QRS.
FREQ VPC	Frequent VPCs. VPC rate (beat/min) reaching or exceeding the preset limit of 1 to 50 beat/min (selectable).
TACHYCARDIA	Tachycardia. Exceeding the upper heart rate limit.
BRADYCARDIA	Bradycardia. Dropping below the lower heart rate limit.

Parameter Alarms

ECG Related Alarms

Alarm Name	Description
CHECK ELECTRODES	Electrode loose or disconnected.
NOISE	(If condition continues for more than 30 seconds) Too much noise preventing analysis.

SpO_2 Related Alarms

Alarm Name	Description
NO PULSE	Pulse cannot be detected.
CHANGE PROBE	SpO2 probe or connection cord is damaged.
CHECK PROBE	Finger probe is not attached to the patient firmly or the amount of transmitted light is too small to measure.
CONNECTOR OFF	SpO2 connection cord is disconnected from the SpO2 socket during monitoring.

NIBP Related Alarms

Alarm Name	Description
CANNOT DETECT PULSE	Measurement cannot be performed because the patient's pulse wave is small, the cuff or hose leaks air, the cuff hose is obstructed or the cuff is not connected.
NIBP SAFETY CIRCUIT RUNNING	Instrument automatically stopped inflating.
SYSTOLIC OVER	Systolic value is outside the measurable range.
MEAS TIME-OUT	The measuring time exceeded the specified time.
CUFF OCCLUSION	Cuff pressure does not decrease after measurement has completed.
AIR LEAK	Cuff pressure does not change after inflation.
CONNECTOR OFF	NIBP hose is disconnected from the cuff socket during monitoring.

IBP Related Alarms

Alarm Name	Description
CHECK SENSOR	Blood pressure transducer is disconnected from the IBP connection cord or the IBP connection cord is damaged.
LABEL DUPLICATED	More than one IBP connection cord with the same label are used.
CONNECTOR OFF	IBP connection cord is disconnected from the socket during measurement.

CO_2 Related Alarms

Alarm Name	Description
CHECK SENSOR	Insufficient sensor light.
CHANGE SENSOR	The CO2 sensor is damaged.
CO2 AUTO ZERO	Zero balance is automatically performed when using a TG-900P CO2 sensor kit.
CONNECTOR OFF	CO2 connection cord is disconnected from the socket during measurement.

Temperature Related Alarms

Alarm Name	Description
CHECK TEMP SENSOR	Temperature sensor is disconnected from the TEMP socket or temperature connection cord is disconnected from the multi-parameter 5 socket, or the probe or connection cord is damaged.
LABEL DUPLICATED	More than one temperature probe with the same label is used.
CONNECTOR OFF	Temperature connection cord is disconnected from the socket during monitoring.

FiO_2 Related Alarms

Alarm Name	Description
CHECK SENSOR	FiO2 sensor is disconnected from the FiO2 connection cord or the FiO2 connection cord is damaged.
CONNECTOR OFF	FiO2 connection cord is disconnected from the socket during monitoring.

CO Related Alarms

Alarm Name	Description
CHECK SENSOR	Tb sensor is disconnected from the CO connection cord or the CO connection cord is damaged.
CONNECTOR OFF	CO connection cord is disconnected from the socket during monitoring.

Other Alarms

Alarm Name	Description
BATTERY WEAK	Battery is getting weak.
PARAMETER DUPLICATED	More than the specified number of channels are used for a parameter.
INSERT NETWORK CARD	The optional QI-101P network card or QI-111P network printer card is disconnected from the monitor.
ALARM bed name	The alarm occurred on an interbed bed.
CANNOT PRINT	Printing failed.

Messages

The following messages are monitoring information and are not considered alarms.

ECG Related Messages

Message	Description
ATTACH ELECTRODES	Attach electrodes to the patient and connect the ECG connection cord (in STANDBY mode).
PACING	Paced QRS is detected. (This message appears only when PACING DETECTION is set to ON.)
LEARNING	Learning QRS for arrhythmia analysis.
ARRHYTHMIA ANALYSIS OFF	Arrhythmia analysis is turned off.
NOISE	(During the first 30 seconds) Too much noise preventing analysis.

Respiration Related Messages

Message	Description
RESP OFF	Respiration monitoring in impedance mode is turned off.
CHECK SENSOR	The respiration pickup is damaged.

SpO_2 Related Messages

Message	Description
ATTACH PROBE	Attach probe to the patient and connect the SpO2 connection cord (in STANDBY mode).
PULSE SEARCH	Searching for the correct pulse wave. Auto gain control is being done. When the message is displayed for more than 20 seconds, the detected pulse is too small to measure.
CHECK PROBE SITE	The probe is not attached to the appropriate site or the probe is damaged.
WEAK PULSE	Poor peripheral circulation.
M (highlighted)	Pulse waveform is not stable.
SpO2 MODULE ERROR	SpO2 hardware malfunction.

NIBP Related Messages

Message	Description
REMEASURING	Remeasuring NIBP.
ZEROING	NIBP zero balance adjustment is performed.
NIBP MODULE FAILURE	NIBP module malfunction.
NIBP MODE CHANGED	Cuff type is changed.
HIGH CUFF PRESS	Excessive pressure is applied by the cuff.
INFLATION PRESS LOW	Insufficient cuff inflation pressure.
WEAK PULSE	Patient’s pulse is small.
PLEASE WAIT	Measurement and cuff inflation started before the cuff is deflated enough.

IBP Related Message

Message	Description
ZERO IMBALANCE	Zero balance is not adjusted.
ZERO OUT OF RANGE	Cannot adjust zero balance.
ZEROING COMPLETE	Zero balance adjustment is complete.
ZERO UNSTABLE	Unstable zero balance.

CO Related Messages

Message	Description
Ti TEMP ERROR	The injectate is not cooled.
Tb TEMP ERROR	The blood temperature is out of range.
Tb OFF	Catheter is disconnected from the CO connection cord or the catheter or CO connection cord is damaged.
OUT OF RANGE	Measured value is outside the measurable range.
BASELINE DRIFT	Baseline is not stable.
THERMODILUTION CURVE ERROR	Returned to the baseline of the thermodilution curve too late.
INJECT	Injectate is not injected.
INJECTION TIME OUT	The injectate is not injected within the specified time.
INFLATE BALLOON	Inflate the balloon.
MEASURING CO	Measuring the CO value.
DETECTING BASELINE	Searching for the baseline of the blood temperature.

CO_2 Related Messages

Message	Description
CAL??	Zero calibration is not performed when using a TG-950P CO_2 sensor kit.
CHANGE ADAPTER	The CO_2 adapter is damaged.

FiO_2 Related Messages

Message	Description
CAL??	Calibration is not performed.
CALIBRATING	Calibration is performed.

Other Messages

Message	Description
SILENCE ALARMS	Alarm is suspended.
SILENCE DIFFERENT ALARMS	Another alarm is suspended during alarm suspension.
REMAINING SUSPEND TIME: X min	Remaining suspended time.
INSERT REC PAPER	No recording paper.
CLOSE PAPER MAGAZINE	Paper magazine is open.
CALIBRATING	Monitor is calibrated.
FREEZE	Waveforms are frozen.
CLOCK IC FAILURE	The clock IC is damaged.
TOUCH KEY OFF	Touch key function is turned off.
NETWORK CARD ERROR	Network card malfunction.
PRINTING	Printing now
AUTO LEAD CHANGE	Monitoring lead is being changed by auto lead change function.
ALL ALARMS OFF	All alarms are OFF.

Alarm Indications

Overview

The monitor can indicate alarms both visually and audibly:

- Alarm sound
- Alarm message or highlighted waveform and numeric data on the screen
- Alarm indicator: red or yellow LED

Alarm control marks indicating that various alarm functions are turned off are also displayed.

There are two color display modes. The color mode and colors are set on the SYSTEM SETUP screen (refer to Section 3).

PARAMETER: Different colors can be set for each parameter. When an alarm occurs, the alarm parameter data is highlighted.

ALARM: The same color is set for all parameters. When an alarm occurs, the alarmed parameter color changes to red or yellow according to the alarm level set on the SYSTEM SETUP screen.

CRISIS: red
WARNING: yellow
ADVISORY: yellow

The alarm indicator indicates three alarm levels: crisis, warning and advisory. The red or yellow lamp blinks according to the alarm level.

CRISIS: Blinking red
WARNING: Blinking yellow
ADVISORY: Lights in yellow

Individual Alarm Indications

The alarm level for the HR, SpO_2, PRESS, NIBP, APNEA, EXTERNAL, ECG CHECK ELECTRODES, SpO_2 CHECK PROBE, CO_2, and arrhythmia (VPC RUN, COUPLET, EARLY VPC, BIGEMINY, FREQ VPC, TACHYCARDIA, BRADYCARDIA) alarms can be selected on the SYSTEM SETUP screen. Refer to Section 3.

Vital Signs Alarms

Alarm	Alarm level	Alarm sound	Alarm display		Sound/ display duration	Alarm indicator LED
			Monitoring Screen	When a window is opened		
HR*/ PR**	CRISIS	Continuous “pips”	Blinking highlighted numeric data	—	During detection	Blinking red
	WARNING	Continuous “bing bongs”	Highlighted numeric data			Blinking yellow
	ADVISORY	“Bong” every 20 seconds	Highlighted numeric data			Lights in yellow
VPC	CRISIS	Continuous “pips”	Blinking highlighted numeric data	—	During detection	Blinking red
	WARNING	Continuous “bing bongs”	Highlighted numeric data			Blinking yellow
	ADVISORY	“Bong” every 20 seconds	Highlighted numeric data			Lights in yellow
ST	WARNING	Continuous “bing bongs”	Highlighted numeric data	—	During detection	Blinking yellow
SpO_2	CRISIS	Continuous “pips”	Blinking highlighted numeric data	Highlighted “SpO2 ALARM” message	During detection	Blinking red
	WARNING	Continuous “bing bongs”	Highlighted numeric data			Blinking yellow
	ADVISORY	“Bong” every 20 seconds	Highlighted numeric data			Lights in yellow
PRESS	CRISIS	Continuous “pips”	Blinking highlighted numeric data	Highlighted “P1/P2/P3 ALARM” message	During detection	Blinking red
	WARNING	Continuous “bing bongs”	Highlighted numeric data			Blinking yellow
	ADVISORY	“Bong” every 20 seconds	Highlighted numeric data			Lights in yellow
APNEA	CRISIS	Continuous “pips”	Highlighted “APNEA ALARM” message		During detection	Blinking red
	WARNING	Continuous “bing bongs”	Highlighted “APNEA ALARM” message			Blinking yellow
	ADVISORY	“Bong” every 20 seconds	Highlighted “APNEA ALARM” message			Lights in yellow
NIBP	CRISIS	Continuous “pips”	Blinking highlighted numeric data	Highlighted “NIBP ALARM” message	During detection	Blinking red
	WARNING	Continuous “bing bongs”	Highlighted numeric data			Blinking yellow
	ADVISORY	“Bong” every 20 seconds	Highlighted numeric data			Lights in yellow
TEMP	ADVISORY	“Bong” every 20 seconds	Highlighted numeric data	Highlighted “TEMP ALARM” message	During detection	Lights in yellow
RR	WARNING	Continuous “bing bongs”	Highlighted numeric data	Highlighted “RR ALARM” message	During detection	Blinking yellow
CO_2	WARNING	Continuous “bing bongs”	Highlighted numeric data	Highlighted “CO2 ALARM” message	During detection	Blinking yellow
FiO_2	WARNING	Continuous “bing bongs”	Highlighted numeric data	Highlighted “FiO2 ALARM” message	During detection	Blinking yellow

* When arrhythmia analysis is turned on, the “TACHYCARDIA” or “BRADYCARDIA” message also appears.

** PR alarm level is the same as PRESS or SpO_2 alarm level.

Arrhythmia Alarms

Alarm	Alarm level	Alarm sound	Alarm display	Sound/display duration	Alarm indicator LED
ASYSTOLE VF VT	CRISIS	Continuous “pips”	Blinking highlighted message	During detection	Blinking red
TACHYCARDIA* BRADYCARDIA*	CRISIS	Continuous “pips”	Blinking highlighted numeric data and message	During detection	Blinking red
	WARNING	Continuous “bing bongs”	Highlighted numeric data and message		Blinking yellow
	ADVISORY	“Bong” every 20 seconds	Highlighted numeric data and message		Lights in yellow
VPC RUN COUPLET EARLY VPC FREQ VPC BIGEMINY	CRISIS	Continuous “pips”	Blinking highlighted message	During detection	Blinking red
	WARNING	Continuous “bing bongs”	Highlighted message		Blinking yellow
	ADVISORY	“Bong” every 20 seconds	Highlighted message		Lights in yellow

* The alarm level is the same as the HR alarm level.

Parameter Alarms

Alarm	Alarm level	Alarm sound	Alarm display		Sound/ display duration	Alarm indicator LED
			Monitoring screen	When a window is open		
CONNECTOR OFF	ADVISORY	“Bong” every 20 seconds	Highlighted message	Highlighted (Parameter name) ALARM message	During detection	Lights in yellow

ECG related alarms

Alarm	Alarm level	Alarm sound	Alarm display	Sound/display duration	Alarm indicator LED
CHECK ELECTRODES	WARNING	Continuous “bing bongs”	Highlighted message	During detection	Blinking yellow
	ADVISORY	“Bong” every 20 seconds	Highlighted message		Lights in yellow
NOISE	WARNING	Continuous “bing bongs”	Highlighted message	(If condition continues for more than 30 seconds) During detection	Blinking yellow

SpO_2 related alarms

Alarm	Alarm level	Alarm sound	Alarm display		Sound/ display duration	Alarm indicator LED
			Monitoring screen	When a window is open		
CHANGE PROBE	WARNING	Continuous “bing bongs”	Highlighted message	Highlighted “SpO2 ALARM” message	During detection	Blinking yellow
CHECK PROBE	WARNING	Continuous “bing bongs”	Highlighted message	Highlighted “SpO2 ALARM” message	During detection	Blinking yellow
	ADVISORY	“Bong” every 20 seconds	Highlighted message	Highlighted “SpO2 ALARM” message		Lights in yellow
NO PULSE	ADVISORY	“Bong” every 20 seconds	Highlighted message	Highlighted “SpO2 ALARM” message	During detection	Lights in yellow

NIBP related alarms

Alarm	Alarm level	Alarm sound	Alarm display		Sound/ display duration	Alarm indicator LED
			Monitoring screen	When a window is open		
CANNOT DETECT PULSE NIBP SAFETY CIRCUIT RUNNING SYSTOLIC OVER MEAS TIME-OUT CUFF OCCLUSION AIR LEAK	ADVISORY	"Bong" every 20 seconds	Highlighted message	Highlighted "NIBP ALARM" message	During detection	Lights in yellow

IBP related alarms

Alarm	Alarm level	Alarm sound	Alarm display		Sound/ display duration	Alarm indicator LED
			Monitoring screen	When a window is open		
CHECK SENSOR LABEL DUPLICATED	ADVISORY	"Bong" every 20 seconds	Highlighted message	Highlighted "P1/P2/P3 ALARM" message	During detection	Lights in yellow

CO_2 related alarms

Alarm	Alarm level	Alarm sound	Alarm display		Sound/ display duration	Alarm indicator LED
			Monitoring screen	When a window is open		
CHECK SENSOR CHANGE SENSOR	ADVISORY	"Bong" every 20 seconds	Highlighted message	Highlighted "CO2 ALARM" message	During detection	Lights in yellow

Temperature related alarms

Alarm	Alarm level	Alarm sound	Alarm display		Sound/ display duration	Alarm indicator LED
			Monitoring screen	When a window is open		
CHECK TEMP SENSOR LABEL DUPLICATED	ADVISORY	"Bong" every 20 seconds	Highlighted message	Highlighted "TEMP ALARM" message	During detection	Lights in yellow

FiO_2 and CO related alarms

Alarm	Alarm level	Alarm sound	Alarm display		Sound/ display duration	Alarm indicator LED
			Monitoring screen	When a window is open		
CHECK SENSOR	ADVISORY	"Bong" every 20 seconds	Highlighted message	Highlighted "FiO2/CO ALARM" message	During detection	Lights in yellow

Other Alarms

Alarm	Alarm level	Alarm sound	Alarm display	Sound/display duration	Alarm indicator LED
BATTERY WEAK	WARNING	Continuous "bing bongs"	Highlighted message	During detection	Blinking yellow
PARAMETER DUPLICATED					
INSERT NETWORK CARD	ADVISORY	"Bong" every 20 seconds	Highlighted message	During detection	Lights in yellow

Interbed Alarms

The interbed alarm indication depends on the INTERBED ALARM setting on the SETTING window of the INTERBED window. Refer to Section 10.

When set to ON, the highlighted "ALARM bed name" message is displayed with three "bing" sounds. When set to OFF, only the non-highlighted message is displayed.

Alarm Control Marks

When certain alarm functions are not available, an alarm control mark is displayed in the upper right corner of the screen.

Alarm Suspend Mark

Remaining minutes is indicated beside the bell.

Alarm Recording Off Mark

Alarm recording is disabled.

Priority of Alarm Control Marks

If more than one alarm control condition exists at the same time, only the highest priority mark is displayed.

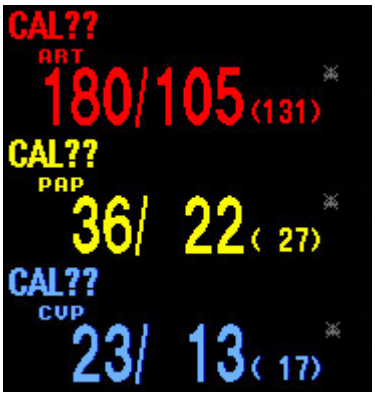
The priority, from high to low, is:

Alarm Suspend mark, Alarm Recording Off mark

Individual Vital Signs Alarm Off Marks

The vital signs alarm off mark can be displayed at every parameter which has the vital signs alarm limit set to OFF. The upper/lower alarm limits can also be displayed at each parameter. This mark is not related to the above alarm control marks.

Set this setting at ALARM LIMIT DISPLAY of the ALARM SETUP on the SYSTEM SETUP screen. See Section 3. The default setting is MARK ON.



ALARM LIMIT DISPLAY set to MARK ON

ALARM LIMIT DISPLAY set to VALUES

Adjusting the Alarm Sound Volume

The alarm sound volume can be adjusted on the SOUND & BRIGHT window. Refer to “Changing Sound Settings” in Section 4.

Temporarily Silencing/Suspending Alarms

Overview

When an alarm occurs, you can silence the alarm sound and indications for one or two minutes. When a vital signs alarm or arrhythmia alarm is silenced, the alarm resumes after the alarm silence ends. When an alarm other than a vital signs or arrhythmia alarm is silenced, the alarm indication does not resume after the alarm silence ends. When several alarms occur together and the SILENCE ALARMS key is pressed, all alarms are silenced.

All alarms can also be suspended before they occur. This monitor has two types of alarm suspension:

- Suspending all alarms for two minutes. For example: for electrode replacement, etc.
- Suspending all alarms indefinitely. For example: when the patient is connected to a heart-lung machine or being examined.

The interbed alarm can only be suspended on the alarmed bed.

Silencing Alarms After Alarm Occurrence

During alarm silence,

- the suspended mark and the remaining minutes are displayed
- the alarm sound is silenced

The alarm silence time can be set to either 1 or 2 minutes at the SYSTEM SETUP screen (Section 3). The default setting is 2 minutes.

If another alarm occurs during alarm silence, the alarm sound, indication and recording occur as usual. The alarm silence does not affect alarms which occur after the SILENCE ALARMS key is pressed. (A new occurrence of the silenced alarm condition is treated as a different alarm.) When this alarm is silenced, the "SILENCE DIFFERENT ALARMS" message appears and the alarm suspend time is reset.

Silencing Alarm

SILENCE ALARMS

Press the SILENCE ALARMS key on the front panel. The "SILENCE ALARMS" message and an alarm silenced mark with the minutes remaining in the alarm silence are displayed on the screen.

Canceling Alarm Silence

Vital sign and arrhythmia alarm silence can be cancelled by pressing the SILENCE ALARMS key. The alarm silence mark disappears and all alarms are resumed. Parameter alarm and other alarm silence cannot be cancelled.

Suspending Alarms

Suspending Alarms for Two Minutes

During alarm suspension, all alarms are suspended and

- the “REMAINING SUSPEND TIME” message is displayed
- the alarm sound is silenced
- all alarm recording is suspended.

The alarm suspend time is 2 minutes.

WARNING

All alarms are suspended during two minutes alarm suspension.

Suspending Alarms Indefinitely

You can suspend all alarms for an indefinite time by pressing the “BYPASS” key in OR mode or the “SUSPEND MONITORING” key in ICU or NICU mode on the MENU window.

WARNING

All alarms are suspended for an indefinite period.

In ICU or NICU mode

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “SUSPEND MONITORING” key.

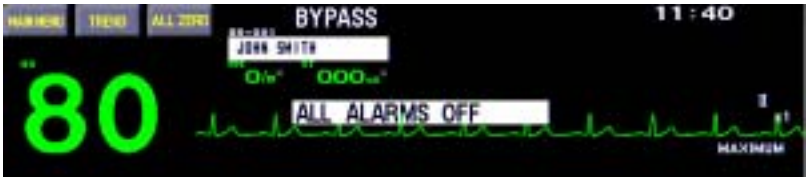
NIBP measurement in STAT and Auto mode is suspended until the ◇/▽ NIBP START/STOP key is pressed. Refer to Section 14.

To resume alarms, press the “SUSPEND MONITORING” key again. In ICU or NICU mode, alarms resume and the “SUSPEND MONITORING” key returns to the off position when heart rate, SpO_2, IBP, CNIBP or $EtCO_2$ (except $EtCO_2$ measured by AG-920RA multigas unit) is monitored properly for the time length set on the SUSPEND ALARM TIME on the SYSTEM SETUP screen or when NIBP is measured. For the time length setting, refer to Section 3.

In OR mode

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “BYPASS” key.



NIBP measurement in STAT and Auto mode is suspended until the ◇/▽ NIBP START/STOP key is pressed. Refer to Section 14.

To resume alarms, press the “BYPASS” key again. In OR mode, alarms can only resume by pressing the “BYPASS” key.

Turning Automatic Alarm Recording On/Off

If ALARM RECORDING on the RECORDING window is set to ON, waveforms beginning 8 seconds before and ending 12 seconds after the alarm are automatically recorded when an alarm is generated. If this setting is OFF, an All Vital Signs Alarm Recording Off mark appears at the upper right corner of the screen and the waveforms are not automatically recorded when an alarm occurs. You can still record waveforms manually.

Recording is only available on the BSM-4101/4102/4103/4104 monitors.

You can select which waveform(s) to record by changing the recording pattern. See Section 8.

To cancel recording while an automatic vital signs alarm is being recorded, press the record key on the front panel.

To set automatic vital signs alarm recording on or off:

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “RECORDING” key to display the RECORDING window.

3. Touch the “ON” or “OFF” key in the ALARM RECORDING box to set alarm recording on or off.

4. Press the HOME key on the front panel to return to the monitoring screen.

Setting Alarm

Overview

There are three ways to set alarm limits and on/off settings:

- Set all alarm limits at the same time on one window.
- Set a group of alarm items all together to a preset pattern using an alarm master.
- Set the alarms for individual parameters separately from the ECG, SpO_2, NIBP, IBP, respiration, CO_2, temperature and FiO_2 windows. See Sections 11 to 19.

Vital signs alarm limits can be set on two different windows: the VITAL ALARM window and the VITAL ALARM window for the individual parameter. When you change an alarm setting on one window, the same setting on the other window is also automatically changed.

Arrhythmia alarm limits can be set on two different windows: the ARRHYTH ALARM window and the ARRHYTH ALARM window of the ECG window. When you change an alarm setting on one window, the same setting on the other window is also automatically changed.

The alarm setting remains in memory for about 30 minutes after the power off. After 30 minutes, the setting returns to the alarm master setting.

To set NIBP alarm limits for neonate, the cuff for neonates must be connected to the cuff socket on the monitor.

Alarm Limits Ranges

The following tables show the setting ranges for each alarm. Any upper and lower limit can also be set to off.

CAUTION

When the alarm limit is set to OFF, there will be no alarm for that limit.

Vital Signs Alarms

If the upper limit is set to a value above the maximum, or the lower limit is set to a value below the minimum, the alarm for that upper/lower limit is automatically set to OFF.

Items	Setting Range	Default Setting	Step
HR/PR (beats/min)	Upper: 20 to 300, OFF Lower: 15 to 295, OFF	Upper OR, ICU: 140 NICU: 180 Lower OR, ICU: 40 NICU: 80	5
RR (breaths/min)	Upper: 2 to 150, OFF Lower: 0 to 148, OFF	Upper: OFF Lower: OFF	2
APNEA (s)	5 to 40, OFF	20	5
SpO2 (%)	Upper: 51 to 100, OFF Lower: 50 to 99, OFF	Upper: OFF Lower: 90	1
EtCO2 (mmHg)	Upper: 2 to 99, OFF Lower: 1 to 98, OFF	Upper: OFF Lower: OFF	1
EtCO2 (kPa)	Upper: 1.0 to 13.5, OFF Lower: 0.5 to 13.0, OFF	Upper: OFF Lower: OFF	0.5
FiCO2 (mmHg)	Upper: 1 to 5, OFF	OR: 3 ICU, NICU: OFF	1
FiCO2 (kPa)	Upper: 0.1 to 0.7, OFF	OR: 0.4 ICU, NICU: OFF	0.1
FiO2 (%)	Upper: 19 to 100, OFF Lower: 18 to 99, OFF	Upper: OFF Lower: 18	1
NIBP (mmHg)	Upper: 15 to 260, OFF Lower: 10 to 255, OFF	Upper: SYS: adult/child 180, neonate 100, DIAS: OFF, MEAN: OFF Lower: SYS: adult/child 80, neonate 40, DIAS: OFF, MEAN: OFF	5
NIBP (kPa)	Upper: 1.5 to 35.0, OFF Lower: 1.0 to 34.5, OFF	Upper: SYS: adult/child 24.0, neonate 13.5 DIAS: OFF, MEAN: OFF Lower: SYS: adult/child 10.5, neonate 5.5 DIAS: OFF, MEAN: OFF	0.5
ST (mV)	Upper: –1.99 to +2.00, OFF Lower: –2.00 to +1.99, OFF	Upper: +0.5 Lower: –0.5	0.01
ST (mm)	Upper: –19.9 to +20.0, OFF Lower: –20.0 to +19.9, OFF	Upper: +5.0 Lower: –5.0	0.1
IBP (mmHg)	Upper: 2 to 300, OFF Lower: 0 to 298, OFF	Upper SYS: OFF, DIAS: OFF, MEAN: OFF Lower P1 SYS OR, ICU: 80 NICU: 50 Lower DIAS: OFF Lower P1 MEAN OR, ICU: 60 NICU: 30 Others SYS: OFF, DIAS: OFF, MEAN: OFF	2
IBP (kPa)	Upper: 0.5 to 40.0, OFF Lower: 0.0 to 39.5, OFF	Upper SYS: OFF, DIAS: OFF, MEAN: OFF Lower P1 SYS OR, ICU: 10.0 NICU: 6.0 Lower DIAS: OFF Lower P1 MEAN OR, ICU: 8.0 NICU: 4.0 Others SYS: OFF, DIAS: OFF, MEAN: OFF	0.5
TEMP (°C)	Upper: 0.1 to 45.0, OFF Lower: 0 to 44.9, OFF	Upper OR, ICU: delta T OFF Others 38.0 NICU: delta T OFF, Others 39.0 Lower: OFF	0.1
TEMP (°F)	Upper: 33 to 113, OFF Lower: 32 to 112, OFF	Upper OR, ICU: delta T OFF Others 100 NICU: delta T OFF, Others 102 Lower: OFF	1

Arrhythmia Alarms

Parameter	Detection condition (Default setting)	Alarm ON/OFF setting (Default setting)
ASYSTOLE	3 to 10 seconds (OR, ICU: 5 s NICU: 3 s)	ON fixed
VF	—	ON fixed
VT	—	ON fixed
VPC RUN	3 to 8 VPCs (3 VPCs)	ON/OFF (ICU: ON OR, NICU: OFF)
COUPLET	—	ON/OFF (OFF)
EARLY VPC	—	ON/OFF (OFF)
BIGEMINY	—	ON/OFF (OFF)
FREQ VPC	1 to 50 VPCs/min (10 VPCs/min)	ON/OFF (OFF)

Setting Vital Signs Alarm Individually

1. Press the MENU key on the front panel. The MENU window appears.

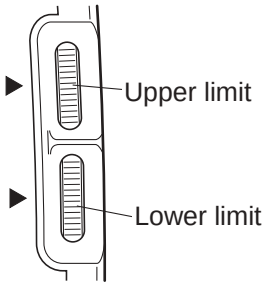
2. Touch the “VITAL ALARM” key. The VITAL ALARM window appears.

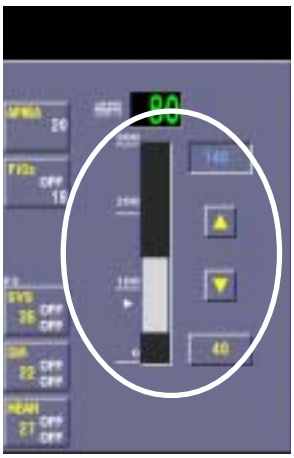
3. Touch the parameter key for the limit you want to change.

4. Do one of the following:

   Use the function dials to change settings.

   Or,





1) Touch the upper limit key to set the upper limit or touch the lower limit key to set the lower limit.

2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

Or,

Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

5. Repeat steps 3 and 4 to change other parameter alarm settings.

6. Press the HOME key on the front panel to return to the monitoring screen.

Setting All Vital Signs Alarms to a Preset Pattern (Alarm Master)

For fast and easy alarm setup, a group of alarm items can be set all together to one group of preset settings. This is called an alarm master. This is useful, for example, if there are typical alarm settings at your hospital, or you have certain alarm settings for certain patients.

You can also change individual alarm settings, as described in previous pages, after setting all alarms with an alarm master.

To change the individual settings in an alarm master, refer to “Changing the Settings” in Section 3.

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “VITAL ALARM” key. The VITAL ALARM window appears.

3. Touch the “APPLY MASTER” key. The “APPLY SETTING FROM MASTER?” message appears.

4. Touch the “YES” key to change all settings to the value set on the ALARM MASTER of the SYSTEM SETUP screen.

   Touch the “NO” key to cancel changing the alarm settings to the alarm master setting.

5. Press the HOME key on the front panel to return to the monitoring screen.

HOME

Setting Arrhythmia Alarms Individually

For details about arrhythmia monitoring, refer to “Monitoring Arrhythmia” in Section 11.

WARNING

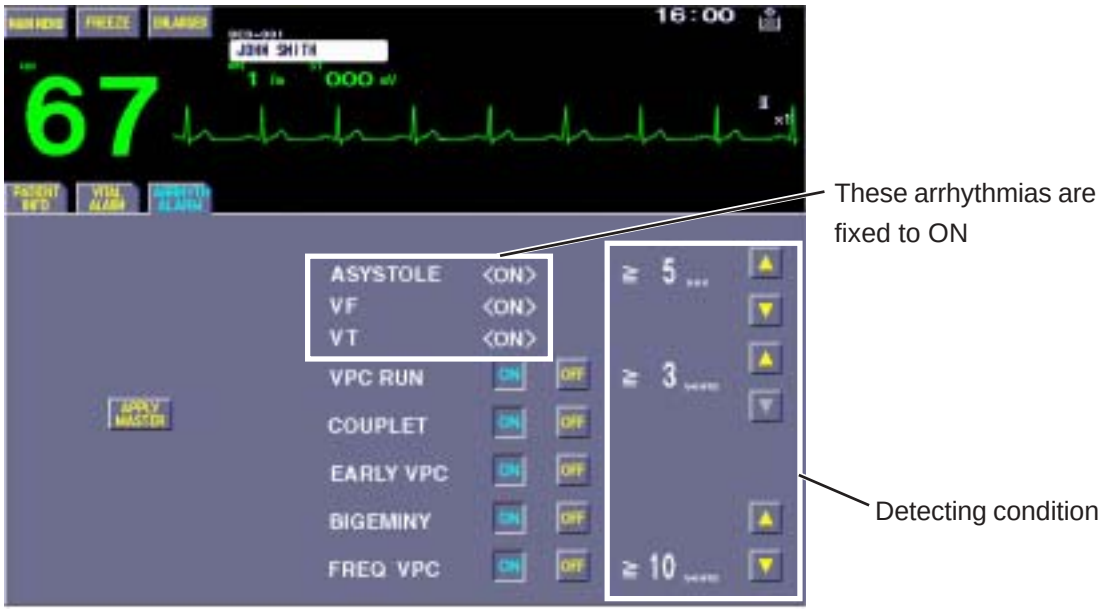
For arrhythmia monitoring, set ARRHYTHMIA ANALYSIS on the ECG OTHER SETTING window to ON. Otherwise, there is no sound or indication for arrhythmia alarms.

CAUTION

When the alarm is turned OFF for an arrhythmia, there will be no alarm for that arrhythmia type. There is no message or mark to indicate that a certain arrhythmia alarm is turned off, therefore, take care when turning off an arrhythmia alarm.

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “ARRHYTH ALARM” key. The ARRHYTH ALARM window appears.



3. Touch the “ON” or “OFF” key for each arrhythmia type to set it on or off.

4. For “ASYSTOLE”, “VPC RUN” and “FREQ VPC”, set the detecting condition with the ▲ or ▼ key.

5. Press the HOME key on the front panel to return to the monitoring screen.

Setting All Arrhythmia Alarms to a Preset Pattern (Alarm Master)

For fast and easy alarm setup, a group of alarm items can be set all together to one group of preset settings. This is called an alarm master. This is useful, for example, if there are typical alarm settings at your hospital, or you have certain alarm settings for certain patients.

You can also change individual alarm settings, as described in previous pages, after setting all alarms with an alarm master.

To change the individual settings in an alarm master, refer to “Changing the Settings” in Section 3.

WARNING

For arrhythmia monitoring, set ARRHYTHMIA ANALYSIS on the ECG OTHER SETTING window to ON. Otherwise, there is no sound or indication for arrhythmia alarms.

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “ARRHYTH ALARM” key. The ARRHYTH ALARM window appears.

3. Touch the “APPLY MASTER” key. The “APPLY SETTING FROM MASTER?” message appears.

4. Touch the “YES” key to change all settings to the values on the ALARM MASTER of the SYSTEM SETUP screen.

   Touch the “NO” key not to change the alarm settings to the alarm master settings.

5. Press the HOME key on the front panel to return to the monitoring screen.

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General

You can review saved data on the following review windows.

- Trend window: Displays trendgraphs of the past 24 hours.
- List window: Displays vital sign data as a list. There is a periodic vital signs list and a NIBP list. Up to 120 files can be saved for each list type.
- Arrhythmia recall window: Displays arrhythmia waveforms of 4 seconds before and 4 seconds after the arrhythmia detection. Up to 16 files can be saved. When the optional QM-421P flash disk card is installed in the monitor, up to 100 files can be saved.
- Hemodynamics window: Displays hemodynamics data as a list when CO is monitored. Up to 8 files can be saved. Available only on the BSM-4103/4104/4113/4114 monitors.
- Full disclosure window: Displays up to 48 hours of compressed ECG. Available only when the optional QM-421P flash disk card is installed in the monitor.
- ST level recall window: Displays up to 500 files of ST level waveforms. Available only when the optional QM-421P flash disk card is installed in the monitor.
- Alarm history window: Displays the list of vital sign alarms and arrhythmia alarms. Up to 200 files can be saved.

Trend Window

Overview

On the TREND window, HR and 3 other selected parameters trendgraphs of the past 24 hours are displayed (multi-parameter trendgraphs). A single trendgraph of the above parameters can be displayed below the multi-parameter trendgraphs with 1, 2, 4, 8 or 24 hour trend time to show more details. You can record trendgraphs on the BSM-4101/4102/4103/4104 monitors.

The maximum, mean and minimum values of all monitoring parameters are automatically acquired every 1 minute for the trendgraph. The acquired values are 1 minute averaged data. The frequency of data display depends on the selected trend time.
1, 2, 4 or 8 hours: 1 minute
24 hours: 3 minutes

NOTE

The stored data remains in memory for about 30 minutes after the power is turned off. After 30 minutes, the stored data is lost.

The following table shows the available trend parameters, screen displays and scales.

Parameter	Description	Vertical Scale Range
HR	Heart rate (beats/min)	0-300, 0-200, 0-100
PR	Pulse rate (beats/min)	0-300, 0-200, 0-100
VPC	VPC rate (VPCs/min)	0-300, 0-100, 0-50, 0-20
ST	ST level (mV)	–2.0 - +2.0, –1.0 - +1.0, –0.5 - +0.5, –0.2 - +0.2
RR	Respiration rate (breaths/min)	0-150, 0-50
APNEA T	Apnea time (Total time in one data segment, in seconds)	0-180, 0-120, 0-60
APNEA F	Apnea frequency (Total number of apnea occurrences in one data segment)	0-12, 0-6
SpO_2	Saturated oxygen from pulse oximeter (%)	80-100, 50-100, 0-100
NIBP	NIBP (mmHg, kPa)	0-300, 0-200, 0-100 (mmHg) 0-40.0, 0-26.7, 0-13.3 (kPa)
P1, P2, P3	IBP (mmHg, kPa)	0-300, 0-200, 0-160, 0-100, 0-50, 0-20 (mmHg) 0-40.0, 0-26.7, 0-21.3, 0-13.3, 0-6.7, 0-2.7 (kPa)
T1, T2	Temperature (°C, °F)	0-40, 20-40, 34-40 (°C) 20-120, 80-120, 92-104 (°F)
$ETCO_2$	End tidal CO_2 partial pressure (mmHg, kPa)	0-80, 0-40, 0-20 (mmHg) 0-10.7, 0-5.3, 0-2.7 (kPa)
FiO_2	Inspired oxygen concentration (%)	0-100, 0-60, 30-60
CNIBP*	Continuous NIBP (mmHg, kPa)	0-300, 0-200, 0-160, 0-100, 0-50, 0-20 (mmHg) 0-40.0, 0-26.7, 0-21.3, 0-13.3, 0-6.7, 0-2.7 (kPa)
EVENT	Events (arrhythmia, OFF**)	————

* Available when the optional AP-400R non-invasive blood pressure unit is used.
** OFF indicates monitoring pause and arrhythmia analysis off. When the arrhythmia analysis is turned off, an arrhythmia event trendgraph is not created.

Displaying the TREND Window

MENU

1. Press the MENU key on the front panel. The MENU screen appears.

2. Touch the “TREND” key to display the TREND window.

Select up to 3 parameters for the multi-parameter trendgraph

Area displayed on the single parameter trendgraph

Multi-parameter trendgraph
HR and up to 3 other parameters can be displayed. You can select up to 3 parameters for acquiring and displaying the trendgraphs.

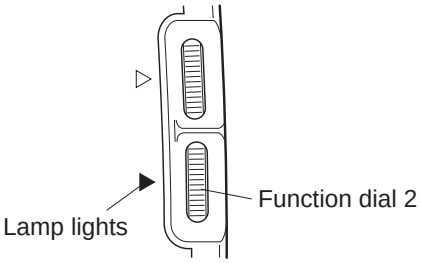
Single parameter trendgraph
One parameter from the multi-parameter trendgraph can be displayed.

You can select up to 3 parameters for acquiring and displaying the trendgraphs. The cursor on the multi-parameter trendgraph shows the part displayed on the single parameter trendgraph.

HOME

3. Press the HOME key on the front panel to return to the monitoring screen.

Single Parameter Trendgraph



You can zoom out or zoom in the single parameter trendgraph. Every time the key is touched, the trend time changes as follows.
ZOOM OUT: 1 hour →2 hours →4 hours →8 hours →24 hours
ZOOM IN: 24 hours →8 hours →4 hours →2 hours →1 hour

The single parameter trendgraph can be scrolled by touching the ◀ or ▶ key on the scroll bar or using the function dial 2.

Selecting Parameter and Scale for the Single Parameter Trendgraph

You can change the parameter and the scale of the single parameter trendgraph. The same scale is used for the multi-parameter trendgraph on the TREND window and the trendgraph on the monitoring screen.

1. Touch the “SINGLE TREND” tab on the TREND window.

2. Select the parameter by touching the desired parameter key.

   You can change the scale of the single parameter trendgraph by touching the desired scale in the SCALE box.

Changing the Time Threshold for Apnea Trendgraph

When APNEA is selected for saving trend data, the time threshold can be selected.

1. Touch the “APNEA INTERVAL” tab on the TREND window. The APNEA INTERVAL window appears.

2. Select the desired time (in seconds) for the apnea trendgraph.

Recording the Trendgraph

The trendgraph displayed in the single parameter trendgraph can be recorded on the BSM-4101/4102/4103/4104 monitors.

Display the parameter you want to record on the single parameter trendgraph and touch the “RECORD” key.

To stop recording the trendgraph, touch the “STOP REC” key on the screen or press the record key on the front panel.

Printing the Trendgraph

The trendgraphs displayed on the multi-parameter trendgraph and single trendgraph can be printed when the monitor is connected to a network printer with a QI-111P network printer card.

Display the parameters you want to print on the multi-parameter trendgraph and single trendgraph and touch the “PRINT START” key.

List Window

Overview

The LIST window lists all parameter data that is measured and saved at preset intervals. The list can be recorded on the BSM-4101/4102/4103/4104 monitors. List parameters are:

- Heart rate
- Pulse rate
- VPC
- ST
- Respiration rate
- SpO_2
- NIBP
- P1
- P2
- P3
- T1
- T2
- CO_2
- FiO_2
- CNIBP

You can select the parameters to be displayed on the LIST window on the LIST PARAMETERS window.

There are two types of lists:

- Periodic vital signs list
  Data for all available parameters except for NIBP is automatically entered into the list at periodic intervals. You can change the interval.

- NIBP list (vital signs list with NIBP measurements)
  Data for all parameters is automatically entered into the list every time NIBP is measured.

One window shows 6 measurements (one page). Each measurement appears on a separate line. Up to 120 measurements of NIBP list and up to 120 measurements of periodic vital signs list can be stored in memory. If more than 120 measurements are made, the oldest measurement is deleted.

NOTE

The stored data remains in memory for about 30 minutes after the power is turned off. After 30 minutes, the stored data is lost.

Displaying the LIST Window

1. Press the MENU key on the front panel. The MENU window appears.

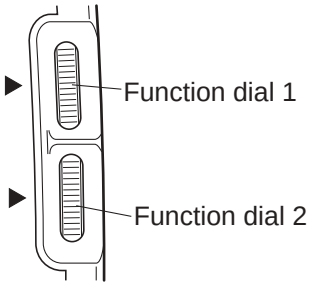
2. Touch the “LIST” key to display the LIST window.

Periodic List

NIBP List

Touch the “PERIODIC” tab to display the periodic vital signs list.

Touch the “NIBP” tab to display the NIBP list.



To see other parameters, use the horizontal scroll bar or the function dial 2 to scroll data sideways.

If the list is larger than one page, use the vertical scroll bar or the function dial 1 to select the page of the list you want to review. A “NEWEST” message appears when the latest page is displayed. An “OLDEST” message appears when the oldest page is displayed.

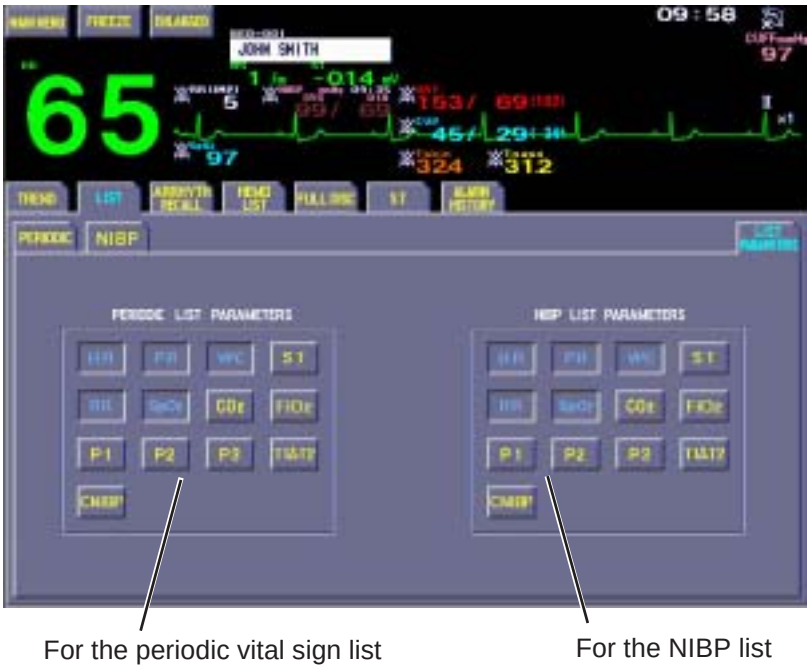
To return to the monitoring screen, press the HOME key on the front panel.

Setting the List Interval for the Periodic Vital Signs List

Select the desired time (minutes) key in the PERIODIC LIST INTERVAL box.

Selecting Parameters to be Displayed on the LIST Window

1. Touch the “LIST PARAMETERS” tab on the LIST window. The LIST PARAMETERS window appears.



2. Select the parameters you want to display on the LIST window.

3. Touch the “PERIODIC” or “NIBP” tab to return to the LIST window. The selected parameters are displayed.

Recording the List

The list data can be recorded on the BSM-4101/4102/4103/4104 monitors.

To record only the data displayed on the LIST window, touch the “RECORD” key.

To record all stored list data, touch the “RECORD ALL” key.

To stop recording the list, touch the “STOP REC” key on the screen or press the record key on the front panel.

Printing the List

The list data can be printed when the monitor is connected to a network printer with a QI-111P network printer card.

To print only the data displayed on the LIST window, touch the “PRINT START” key on the left side of the “RECORD” key.

To print all stored list data, touch the “PRINT START” key on the left side of the “RECORD ALL” key.

Hemodynamics Window

Overview

The hemodynamics list can be created when CO is monitored and the acquired data is registered to this list. The HEMO LIST window is only available on the BSM-4103/4104/4113/4114 monitors. The hemodynamics list displayed on the HEMO LIST window can be recorded on the BSM-4103/4104 monitor.

Up to 8 data can be registered to the hemodynamics list. If more than 8 measurements are made, the oldest measurement data is deleted.

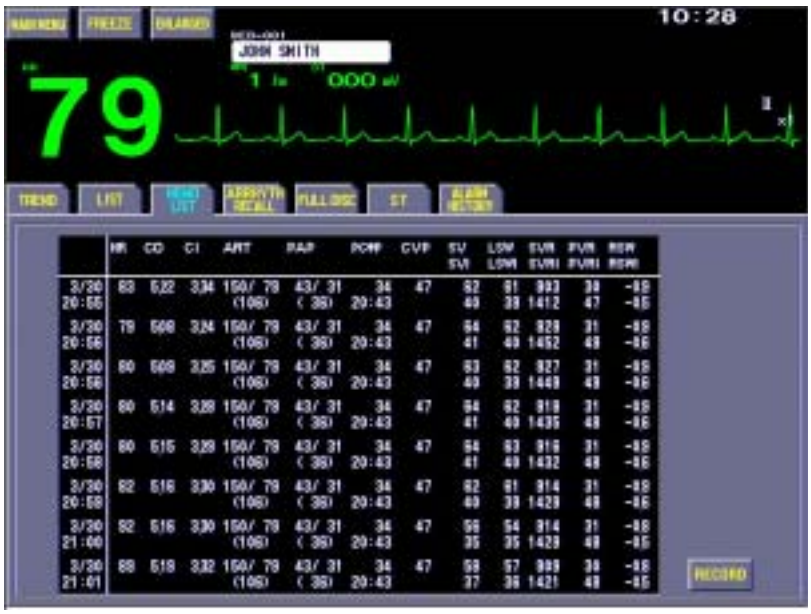
NOTE

The stored data remains in memory for about 30 minutes after the power is turned off. After 30 minutes, the stored data is lost.

Displaying the HEMO LIST Window

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “HEMO LIST” key to display the HEMO LIST window.



HOME

3. Press the HOME key on the front panel to return to the monitoring screen.

Explanation of the Hemodynamics List

Label	Name	Unit	Explanation and Equation
HR	Heart rate	min^{-1}	Heart rate at the time the CO is measured.
CO	Cardiac output	$L \cdot min^{-1}$	—
CI	Cardiac index	$L \cdot min^{-1} \cdot m^{-2}$	CI=CO/BSA
ASP	Arterial systolic pressure	mmHg	Values registered at the time the CO is measured.
ADP	Arterial diastolic pressure		
AMP	Arterial mean pressure		
PASP	Pulmonary arterial systolic pressure		
PADP	Pulmonary arterial diastolic pressure		
PAMP	Pulmonary arterial mean pressure		
PCWP	Pulmonary capillary wedge pressure		
CVP	Central venous pressure mean		
SV	Stroke volume	mL	SV = (CO × 1000)/HR
LSW*	Left ventricular stroke work	$g \cdot m$	LSW = {SV × (AMP – PCWP)} × 0.0136
SVR	Systemic vascular resistance	$dyn \cdot s \cdot cm^{-5}$	SVR = {(AMP – CVP) × 80)}/CO
PVR*	Pulmonary vascular resistance		PVR = {(PAMP – PCWP) × 80}/CO
RSW	Right ventricular stroke work	$g \cdot m$	RSW = {13.6 × CO × (PAMP – CVP)}/HR
SVI	Stroke volume index	$mL \cdot m^{-2}$	SVI = (CI × 1000)/HR
LSWI*	Left ventricular stroke work index	$g \cdot m \cdot m^{-2}$	LSWI = {SVI × (AMP – PCWP)} × 0.0136
SVRI	Systemic vascular resistance index	$dyn \cdot s \cdot cm^{-5} \cdot m^{-2}$	SVRI = {(AMP – CVP) × 80}/CI
PVRI	Pulmonary vascular resistance index		PVRI = {(PAMP – PCWP) × 80}/CI
RSWI	Right ventricular stroke work index	$g \cdot m \cdot m^{-2}$	RSWI = {13.6 × CO × (PAMP – CVP)}/(HR × BSA)

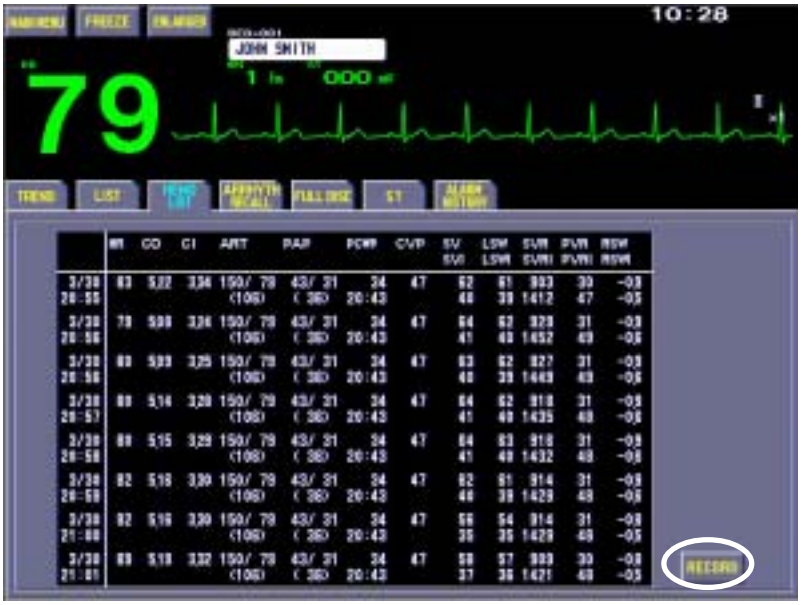
* When PCWP is not measured, "- - -" appears.

Recording the Hemodynamics List

The displayed hemodynamics list can be recorded on the BSM-4103/4104 monitors.

Display the list you want to record on the HEMO LIST window and touch the “RECORD” key.

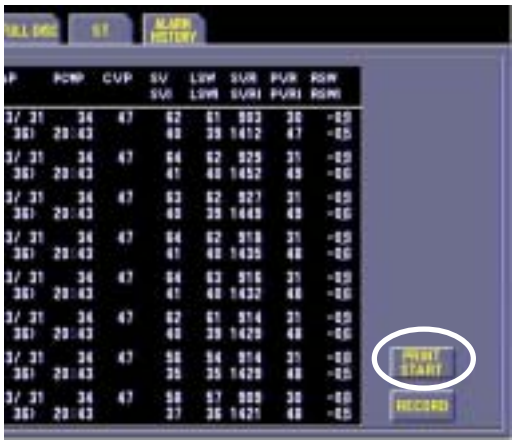
To stop recording the list, touch the “STOP REC” key on the screen or press the record key on the front panel.



Printing the Hemodynamics List

The displayed hemodynamics list can be printed when the monitor is connected to a network printer with a QI-111P network printer card.

To print, touch the “PRINT START” key.



Arrhythmia Recall Window

An ECG waveform of 4 seconds before and 4 seconds after the arrhythmia detection is saved as an arrhythmia recall file. Up to 16 files can be created. When more than 16 files are created, the oldest file is automatically deleted.

When the optional QM-421P flash disk card is installed in the monitor, up to 100 files can be created.

To create arrhythmia recall files:

- ARRHYTHMIA ANALYSIS on the ECG OTHER SETTING window must be set to ON. Refer to “Monitoring Arrhythmia” in Section 11.
- The type of arrhythmias you want to save as files must be selected on the ARRHYTH RECALL window. Refer to the “Selecting the Arrhythmia Types to be Saved as a Recall File” section.

NOTE

The stored data remains in memory for about 30 minutes after the power is turned off. After 30 minutes, the stored data is lost.

The Arrhythmia Recall window lists the recall files at the lower right and the actual size arrhythmia waveform of the selected file is displayed at the top part of the window. All 16 files are listed on one page.

The list on the Arrhythmia Recall window can be refreshed to display the newly created files by touching the “REFRESH” key on the window.

Arrhythmia List

The arrhythmias are listed in the priority of highest to lowest. When several arrhythmias occur at the same time, only the arrhythmia of the highest priority is saved as the recall file.

Arrhythmia	Meaning
ASYSTOLE	Cardiac arrest
VF	Ventricular fibrillation
VT	Ventricular tachycardia
VPC RUN	VPC short run
COUPLET	VPC couplet
EARLY VPC	Early VPC
BIGEMINY	Ventricular bigeminy
TACHYCARDIA	Exceeding the upper heart rate limit
BRADYCARDIA	Dropping below the lower heart rate limit
VPC	Ventricular premature contraction

Arrhythmia Waveform Annotation

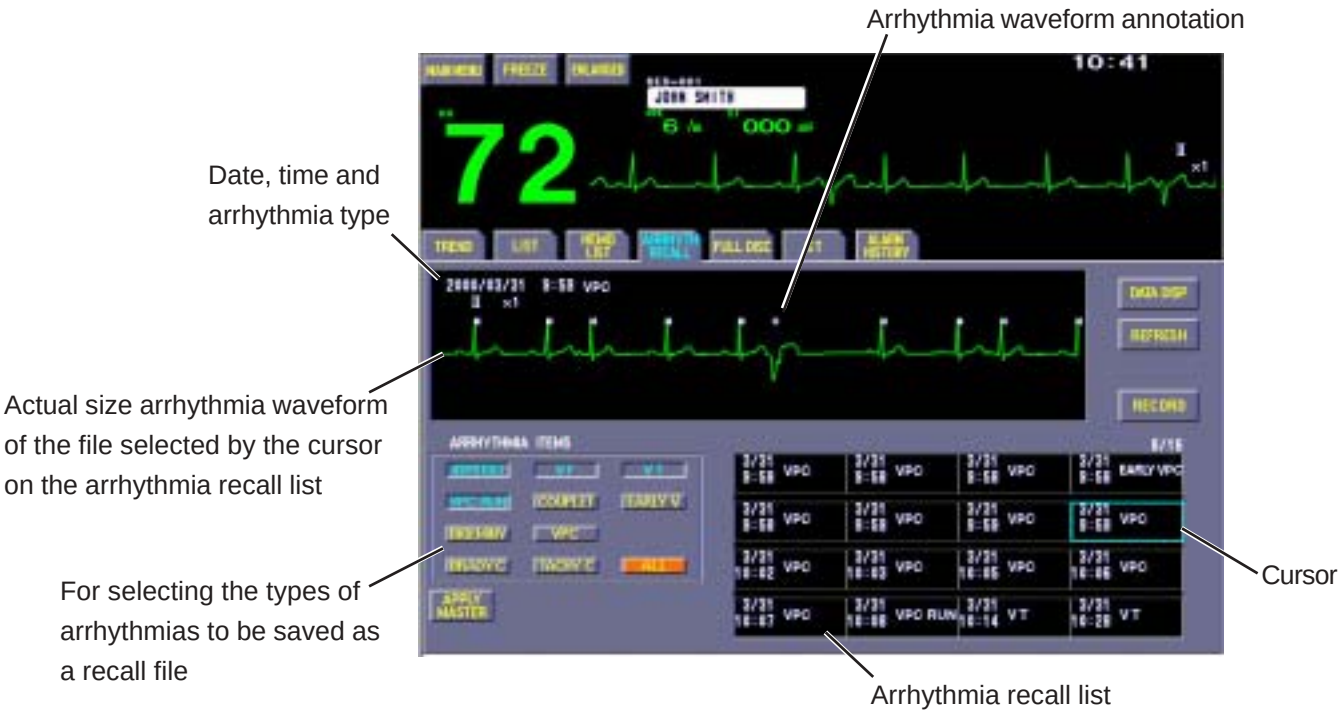
Each beat of a stored arrhythmia waveform is automatically classified and annotated as follows.

Beat Annotation	Description
N	Normal QRS complex (equal to the dominant QRS)
S	Supraventricular premature contraction
V	Ventricular premature contraction
E	Early VPC. VPC with a time interval from the preceding normal QRS complex that is shorter than approx. one-third of the normal R-R interval.
A	Abnormal beat (e.g. ventricular escaped beat)
P	Paced QRS
?	Impossible to classify.
–	Impossible to classify due to noise interference (or during learning).

Displaying the Arrhythmia Recall Window

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “ARRHYTH RECALL” key to display the Arrhythmia Recall window.


Arrhythmia waveform annotation
Date, time and arrhythmia type
Actual size arrhythmia waveform of the file selected by the cursor on the arrhythmia recall list
For selecting the types of arrhythmias to be saved as a recall file
Cursor
Arrhythmia recall list

When there is no recall file, the “NO DATA” message is displayed.

To refresh the list, touch the “REFRESH” key.

When the “DATA DISP” key is touched, the numeric data of all monitoring parameters are displayed below the arrhythmia waveform.

Recording the Arrhythmia Recall Waveform

The displayed arrhythmia waveform can be recorded on the BSM-4101/4102/4103/4104 monitors.

Display the arrhythmia waveform you want to record on the Arrhythmia Recall window and touch the “RECORD” key.

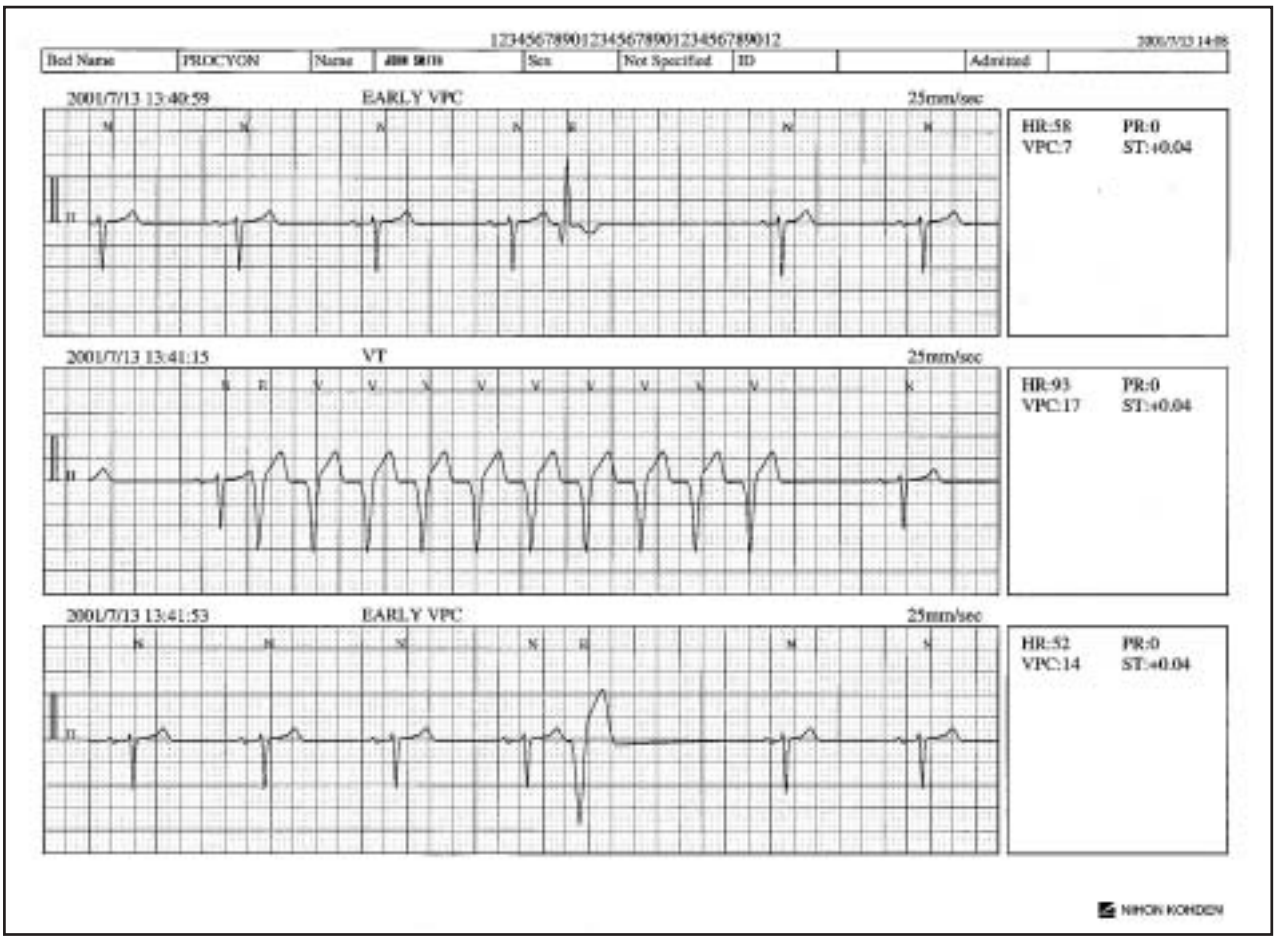
To stop recording the waveform, touch the “STOP REC” key on the screen or press the record key on the front panel.

Printing the Arrhythmia Recall Waveform

The arrhythmia waveform of the selected arrhythmia recall file can be printed when the monitor is connected to a network printer with a QI-111P network printer card. The arrhythmia waveforms one before and one after the selected file are also printed.

To print, touch the “PRINT START” key.

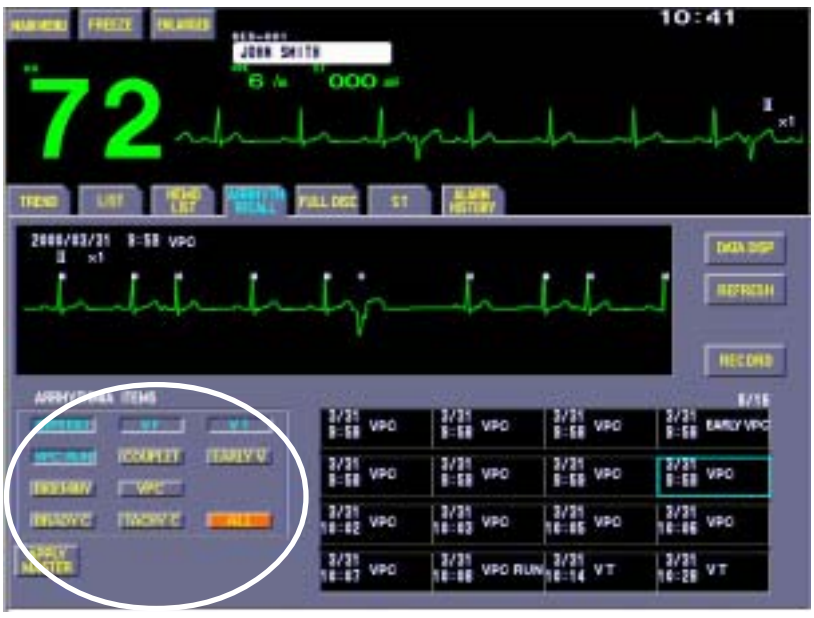
Printing Example



Selecting the Arrhythmia Types to be Saved as a Recall File

Select the arrhythmia types to create files for. These settings can be set all together to one group of preset settings called an arrhythmia recall master. The arrhythmia recall master is set on the SYSTEM SETUP screen. Refer to Section 3.

To set individually, touch the desired arrhythmia types in the ARRHYTHMIA ITEMS box. When “ALL” is selected, all arrhythmia types are saved.



To set using the arrhythmia recall master:

1. Touch the “APPLY MASTER” key. The “APPLY SETTINGS FROM MASTER?” message appears.

2. Touch the “YES” key to change all settings to the settings on the ARRHYTHMIA RECALL MASTER of the SYSTEM SETUP screen.

   Touch the “NO” key to cancel changing the settings.

Full Disclosure Window

When the optional QM-421P flash disk card is installed in the monitor, a full disclosure of 48 hours can be saved. The full disclosure ECG waveform can be reviewed, scrolled and recorded, in either compressed or expanded form.

When the QM-421P flash disk card is installed in the monitor, the “FULL DISC” key appears on the MENU window and review windows.

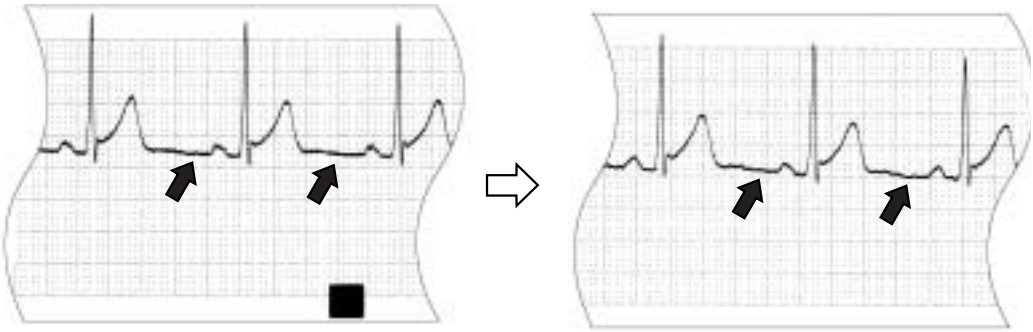
NOTE

The stored data remains in memory for about 30 minutes after the power is turned off. After 30 minutes, the stored data is lost.

The FULL DISC window displays a 3 minute full disclosure ECG with the 30 hour event trendgraph. The 8 second actual size ECG waveform selected by the cursor on the full disclosure is displayed at the bottom part of the window.

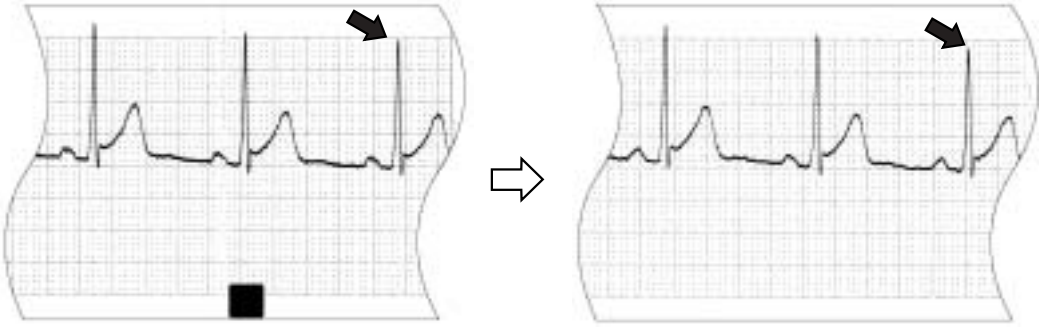
NOTE

When the full disclosure waveform is expanded in actual size, it may be distorted because it has been compressed then expanded. When reading the expanded ECG waveforms, be aware of this distortion.



Original ECG waveform

Expanded ECG waveform
Noise on the ECG between T wave and P wave may become exaggerated



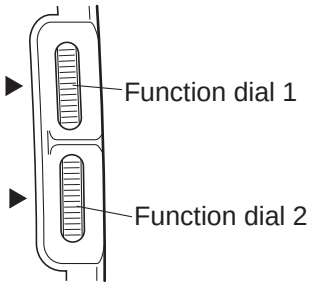
Original ECG waveform

Expanded ECG waveform
QRS amplitude may become smaller and Q wave and S wave may become larger

Displaying the FULL DISC Window

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “FULL DISC” key to display the FULL DISC window.



Use the vertical scroll bar on the window or the function dial 2 on the front panel to scroll the full disclosure waveform vertically. A “NEWEST” message appears when the latest waveform is displayed. An “OLDEST” message appears when the oldest waveform is displayed.

Use the horizontal scroll ◀ or ▶ key beside the event trendgraph or the function dial 1 to scroll the event trendgraph.

When there is no full disclosure waveform, the “NO DATA” message is displayed.

When the event trendgraph cursor is moved, the full disclosure corresponding to the cursor position is displayed.

The full disclosure is refreshed every minute.

When the FULL DISC window is called up from the ARRHYTH RECALL window, the full disclosure is displayed with the time of the ARRHYTH RECALL window.

Recording the Full Disclosure Waveform

The displayed full disclosure data and actual size waveform can be recorded on the BSM-4101/4102/4103/4104 monitors.

Recording the Full Disclosure Data

Display the full disclosure waveform you want to record on the FULL DISC window and touch the “RECORD FULL DISC” key.

To stop recording, touch the “STOP REC” key on the window or press the record key on the front panel.

Recording the Actual Size ECG Waveform

Display the actual size ECG waveform you want to record and touch the "RECORD" key.

To stop recording the waveform, touch the "STOP REC" key on the window or press the record key on the front panel.

Printing the Full Disclosure Waveform

The full disclosure waveform can be printed when the monitor is connected to a network printer with a QI-111P network printer card. The 56 second actual size waveform beginning 21 seconds before the cursor position can be printed. When printing the compressed waveform, you can select the recording length on the RECORDING window.

Printing the Compressed Full Disclosure Data

The compressed waveform for the specified length of time can be printed. Select the length on the RECORDING window.

1. Open the RECORDING window by touching the "RECORDING" key on the MAIN MENU window.

2. Touch the "PRINTER" tab on the RECORDING window.

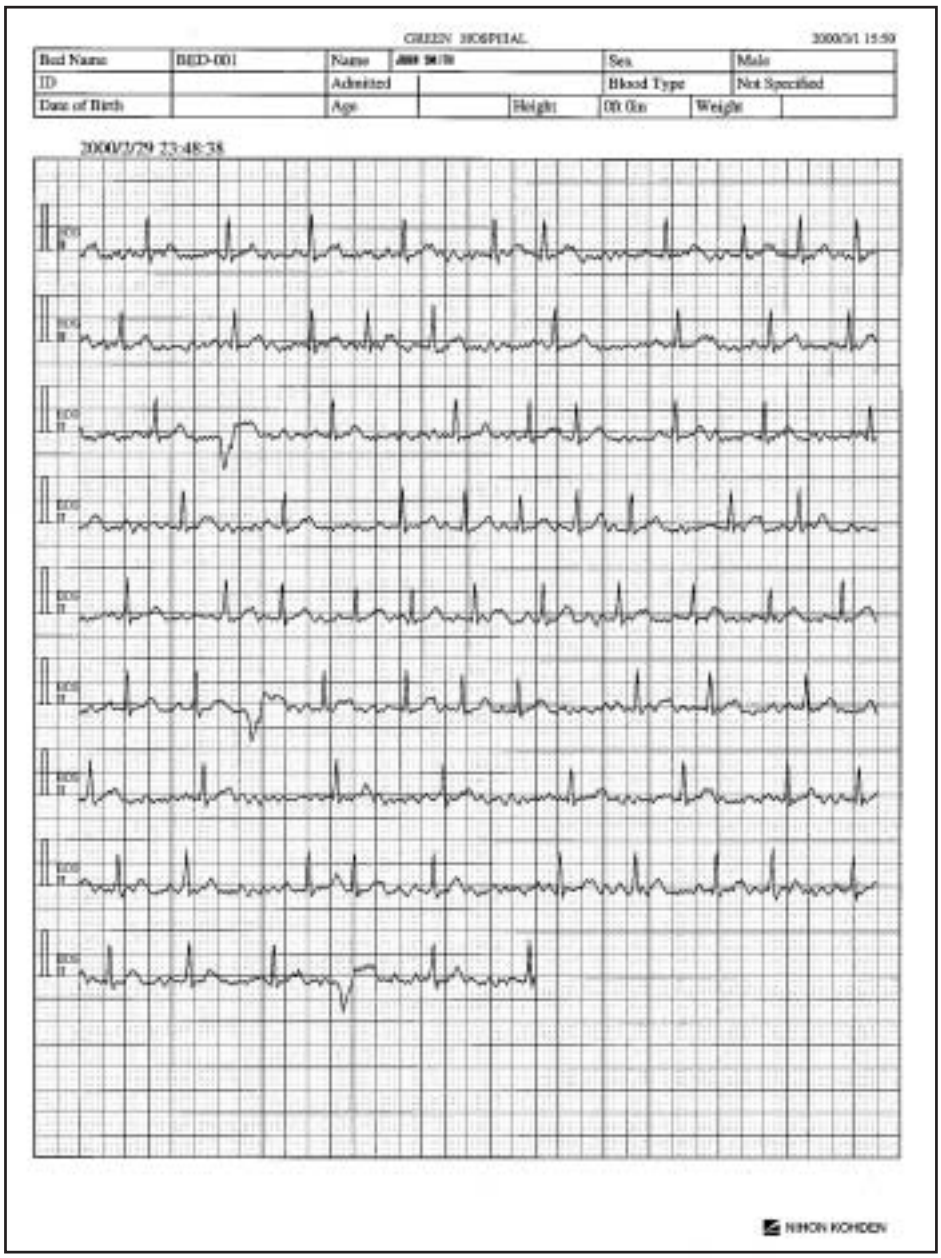
3. Select the waveform length in the “FULL DISCLOSURE RANGE” box. When “ALL” is selected, the entire full disclosure waveform is printed.

4. Touch the “PRINT START” key above the “RECORD FULL DISC” key on the FULL DISC window.

Printing the Actual Size ECG Waveform

To print the actual size waveform, touch the “PRINT START” key above the “RECORD” key. The 56 second actual size waveform beginning 21 seconds before the cursor position is printed.

Printing Example



ST Level Recall Window

When the optional QM-421P flash disk card is installed in the monitor, ST waveform and ST level of the monitoring lead for up to 500 files can be saved at the selected interval. When the monitoring lead is changed on the ECG window, the lead for saving ST level recall files also changes.

When the QM-421P flash disk card is not installed in the monitor, only the ST level measurement setting can be changed.

NOTE

The stored data remains in memory for about 30 minutes after the power is turned off. After 30 minutes, the stored data is lost.

The ST recall window displays 3 files of ST level recall waveforms.

The ST level alarm limits can be set on the VITAL ALARM or ECG window.

The ST level unit (mV or mm) can be set on the SYSTEM SETUP screen. Refer to Section 3.

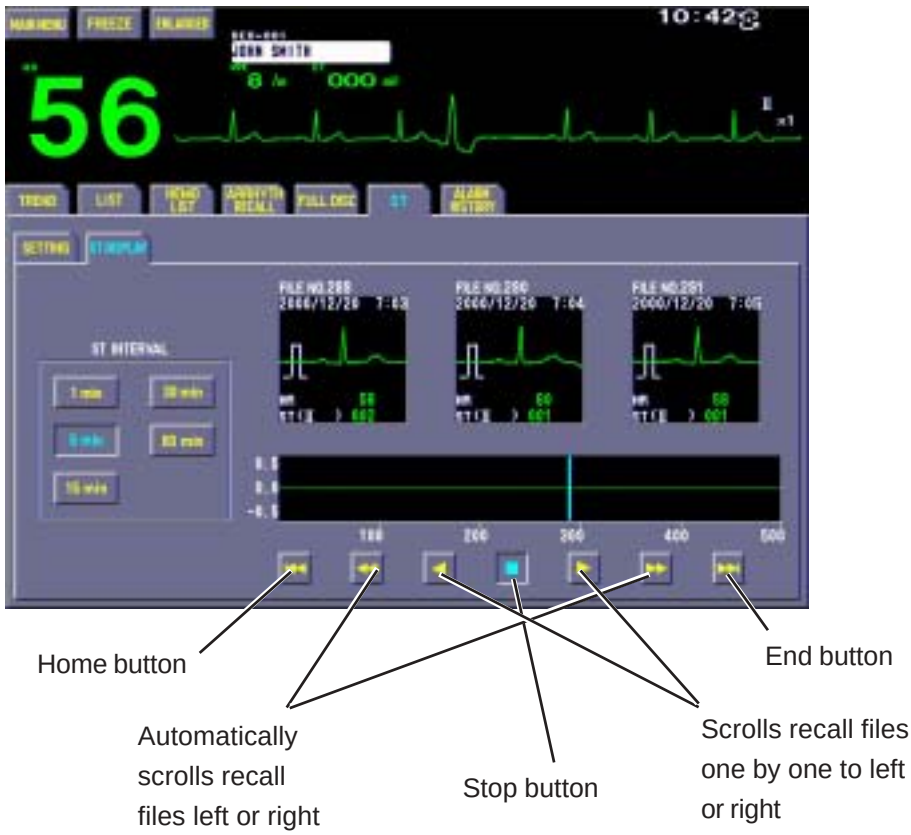
Displaying the ST Window

MENU

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “ST” key to display the ST window.

3. Touch the “ST DISPLAY” tab to display the ST level recall waveform window.



When there is no ST level recall waveforms, the “NO DATA” message is displayed.

Changing the Displaying Interval

Select the desired interval from the ST INTERVAL box.

Changing the ST Level Measurement Condition

You can change the ISO point and ST point for ST level measurement.

1. Touch the “SETTING” tab to display the ST SETTING window.

2. Touch the ◀ or ▶ key to move the vertical cursor left or right for each point. Both cursors move in 4 ms steps. The ISO point can be moved between 4 and 120 ms and the ST point can be moved between 4 and 160 ms. The default settings are 80 ms for the ISO point and 108 ms for the ST point.

   The ISO point determines the baseline and the ST point determines the ST level from the baseline.

   To set the ISO and ST point positions to the default positions (ISO point at 80 ms, ST point at 108 ms), touch the “INITIALIZE” key.

3. To register the ST level measurement condition settings, touch the “APPLY” key. The ST level is measured with the new measurement condition settings.

Alarm History Window

The vital sign alarms and arrhythmia alarms can be listed on the ALARM HISTORY window. Up to 200 data can be saved and up to 8 data can be displayed on the ALARM HISTORY window. The alarm history is created only when a vital sign or arrhythmia alarm occurs.

When the FULL DISC window is displayed from the ALARM HISTORY window, the waveforms of the selected alarm file on the ALARM HISTORY window can be displayed.

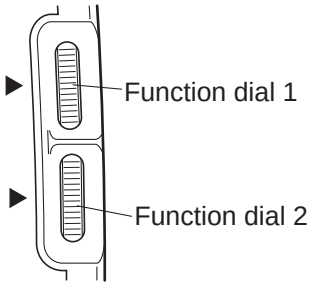
NOTE

The stored data remains in memory for about 30 minutes after the power is turned off. After 30 minutes, the stored data is lost.

Displaying the ALARM HISTORY Window

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “ALARM HISTORY” key to display the ALARM HISTORY window.



Use the function dial 1 to scroll the alarm history list.

Recording the Alarm History Data

To record the displayed alarm history list, touch the “RECORD” key.

To record all alarm history list, touch the “RECORD ALL” key.

Section 8 Recording

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Overview of Recording

A variety of waveforms and data can be recorded on the BSM-4101/4102/4103/4104 monitors on the built-in recorder.

When the BSM-4111/4112/4113/4114 bedside monitor is connected to a central monitor network with the optional QI-101P network card, waveforms and data of the bedside monitor can be recorded manually on the central monitor recorder from the bedside monitor.

When the bedside monitor is connected to a network printer with the optional QI-111P network printer card, real-time waveform printing, printing data on the review windows and printing 12 lead ECG interpretation and analyzed waveforms can be performed. Refer to the “Printing on a Network Printer” section.

This section provides an overview of recording.

The “Changing the Recording Pattern” section explains how to change the recording pattern for all recordings except for the review data recordings.

The “Manually Recording Waveforms” section explains how to manually record waveforms at any time.

The “Setting Periodic Recording” section explains necessary settings for performing automatic periodic recording.

Some recording procedures are explained in other sections.

- To record trendgraphs, see Section 7.
- To record the vital signs list, see Section 7.
- To record hemodynamics list, see Section 7.
- To record arrhythmia recall files, see Section 7.
- To record full disclosure, see Section 7.
- To record alarm history, see Section 7.
- For alarm recording, see Section 6.
- To record waveforms and 12 lead ECG interpretation result on the 12 LEAD window, see Section 5.

To load recording paper, see “Loading the Recording Paper” in Section 2.

For what to do in case of trouble, see Section 20.

Recording Modes

The following recording modes are available.

Recording mode	Recorded data	Length/time of recorded data	Operations/conditions/ settings for recording	Recorded annotation
Real time/ delayed waveform recording*	ECG and a waveform selected on the RECORDING window with numerical data	Time set at MANUAL RECORD TIME on the SYSTEM SETUP screen.	Record key is pressed	MANUAL
			Select second parameter for waveform recording on the RECORDING window	
List recording	List on the window	Data displayed on the window or all saved data	"RECORD" or "RECORD ALL" key on the LIST window is pressed	LIST
Trend recording	Single parameter trendgraph on the window	1 page	"RECORD" key on the TREND window is pressed	TREND
Arrhythmia recall recording	Arrhythmia waveform on the window	8 seconds	"RECORD" key on the ARRHYTH RECALL window is pressed	RECALL
Hemodynamic list recording	Hemodynamics list on the window	4 data × 2 pages	"RECORD" key on the HEMO LIST window is pressed	HEMO
Full disclosure recording	Full disclosure data on the window	3 minutes	"RECORD FULL DISC" key on the FULL DISC window is pressed	FULL DISC
	Actual size waveform on the window	8 seconds	"RECORD" key on the FULL DISC window is pressed	
Alarm history recording	Alarm history on the window	List displayed on the window or all saved list	"RECORD" key or "RECORD ALL" key on the ALARM HISTORY window is pressed	ALARM HISTORY
Recording on the 12 LEAD window	ECG waveforms and analysis result on the window	1 page of analysis result and 10 seconds of ECG waveforms	"RECORD" key on the 12 LEAD window is pressed	–
Recording on the CO window	Up to 5 CO data and one thermodilution curve on the window	1 page	"RECORD" key on the CO window is pressed	–
Vital signs alarm recording	ECG and a waveform selected on the RECORDING window and vital sign data at an alarm occurrence	From 8 seconds before to 12 seconds after alarm occurrence	ALARM RECORDING on the RECORDING window must be set to ON	ALARM
			Alarm for vital signs parameter must be turned on	
			Select second parameter for waveform recording on the RECORDING window	
Arrhythmia alarm recording	ECG and a waveform selected on the RECORDING window and vital sign data at an alarm occurrence	From 8 seconds before to 12 seconds after alarm occurrence	ALARM RECORDING on the RECORDING window must be set to ON	
			Alarm for arrhythmia must be turned on	
			ARRHYTHMIA ANALYSIS on the ECG window must be set to ON	
			Select second parameter for waveform recording on the RECORDING window	
Periodic recording	ECG and a waveform selected on the RECORDING window with numerical data	10 seconds	PERIODIC REC INTERVAL on the RECORDING window must be set to a time interval	TIMER
			Select second parameter for waveform recording on the RECORDING window	
	Trendgraphs of HR, SpO_2 and RR and compressed respiration waveform.	2 pages	PERIODIC REC INTERVAL on the RECORDING window must be set to either 5(OCRG) or 15(OCRG)	OCRG

* Real time or delayed recording can be selected on the SYSTEM SETUP screen. Refer to Section 3. When the BSM-4111/4112/4113/4114 bedside monitor is connected to a central monitor network with the optional QI-101P network card, waveforms and data of the bedside monitor can be recorded manually from the bedside monitor on the central monitor recorder. In this case, only real time recording is available.

Manual Waveform Recording/Printing

ECG and a waveform selected on the RECORDING window are recorded. For details, refer to the "Manually Recording Waveforms" section.

BSM-4101/4102/4103/4104: Recorded on the monitor recorder whenever the record key on the front panel is pressed.

BSM-4111/4112/4113/4114: Not available

BSM-4111/4112/4113/4114 connected to central monitor network with QI-101P: Recorded on the central monitor recorder whenever the record key on the front panel of the bedside monitor is pressed.

BSM-4100 series connected to a network printer with QI-111P: Printed on the network printer whenever the "PRINT" key on the upper left corner of the screen is touched.

Recording/Printing on the 12 LEAD Window

12 lead ECG waveforms and interpretation result displayed on the 12 LEAD window can be recorded. For details, refer to "12 LEAD Window" in Section 5.

BSM-4103/4104: Recorded on the monitor recorder when the "RECORD" key on the 12 LEAD window is pressed.

BSM-4101/4102/4111/4112/4113/4114: Not available

BSM-4103/4104/4113/4114 connected to a CNS-9300 series or CNS-9701 central monitor with QI-101P: Printed on the central monitor printer when the "PRINT START" key on the 12 LEAD window is touched.

BSM-4103/4104/4113/4114 connected to a network printer with QI-111P: Printed on the network printer when the "PRINT START" key on the 12 LEAD window is touched.

Recording/Printing on the Review Windows

Waveforms and data displayed on the review window can be recorded. For details, refer to Section 7.

BSM-4101/4102/4103/4104: Recorded on the monitor recorder when the "RECORD" key on the review window is pressed.

BSM-4111/4112/4113/4114: Not available

BSM-4100 series connected to a network printer with QI-111P: Printed on the network printer when the "PRINT START" key on the review window is touched.

Recording on the CO Window

The CO data displayed on the CO window can be recorded. Recording starts after a few seconds and a blinking mark appears on the upper right corner of the screen. CO can only be recorded on the recorder of the BSM-4101/4102/4103/4104 monitors. For details, refer to "Recording Data on the CO MEASURE Window" in Section 17.

Periodic Recording

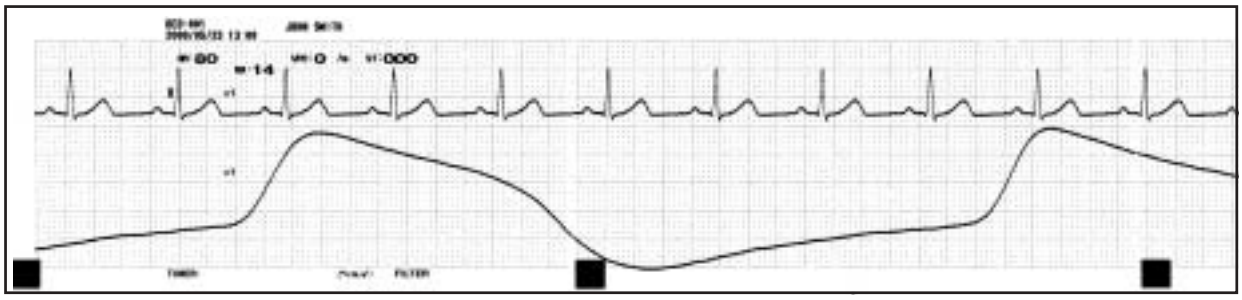
Periodic recording is only available on the BSM-4101/4102/4103/4104 monitor recorder. You can select one of two types of recording data for periodic recording.

- 10 second ECG and a waveform selected on the RECORDING window and vital signs data
- OCRG:
  Trendgraphs of HR, SpO_2 and RR and compressed respiration waveform

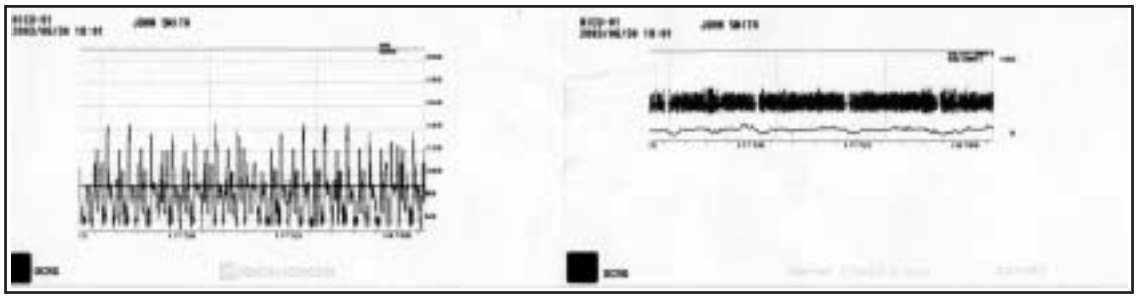
Set the following items on the RECORDING window.

- Periodic recording time interval. When “OFF” is selected, periodic recording is turned off.
- Recording pattern (not necessary when recording OCRG)

Recording example



OCRG recording



Alarm Recording

When a vital sign alarm or arrhythmia alarm occurs, ECG and a waveform selected on the RECORDING window and vital sign data are automatically recorded. The recorded waveforms are from 8 seconds before to 12 seconds after the alarm occurrence. The alarm recording is only available on the BSM-4101/4102/4103/4104 monitor recorder.

Set alarm recording on or off on the RECORDING window. For details, refer to Section 6.

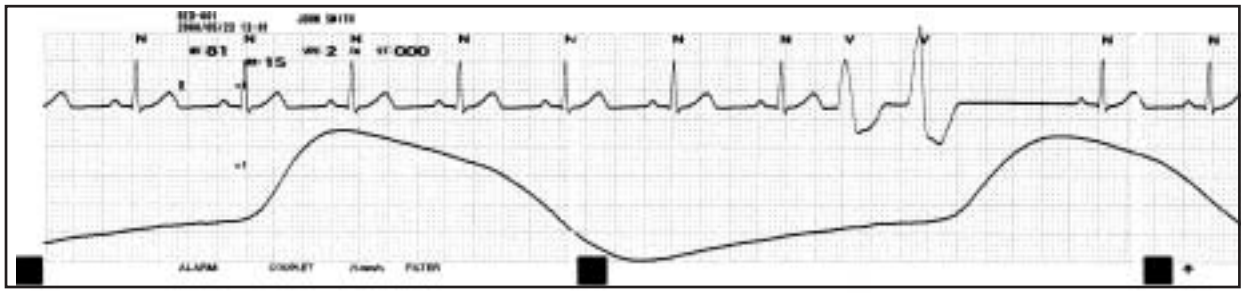
CAUTION

Alarm recording is not performed when:

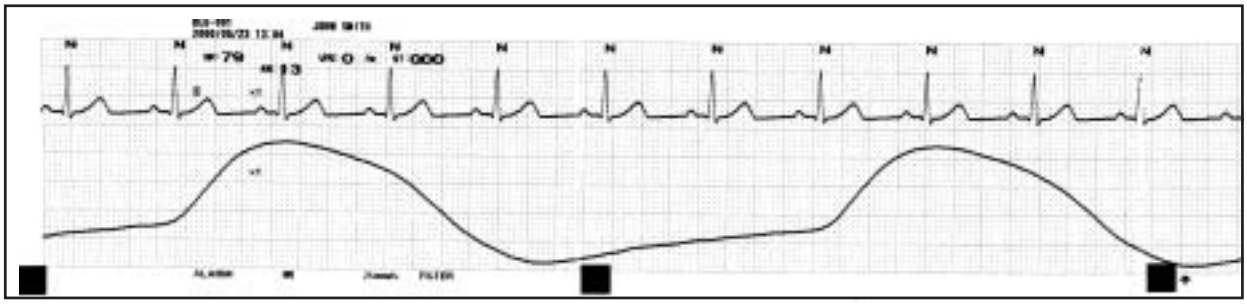
- **Alarm is suspended.**
- **Alarm recording is set to Off.**

Recording example

Arrhythmia alarm recording



Upper/lower limit alarm recording



Recording Mode Annotations

One of the following annotations is recorded on each page of the recording paper as shown below.

TIMER:	Automatic periodic recording. Refer to the “Setting Periodic Recording” section.
ALARM:	Automatic recording at an alarm occurrence. Refer to “Turning Automatic Alarm Recording On/Off” in Section 6.
LIST:	List recording. Refer to “List Window” in Section 7.
TREND:	Trendgraph recording. Refer to “Trend Window” in Section 7.
HEMO:	Hemodynamics list recording. Refer to “Hemodynamics Window” in Section 7.
RECALL:	Arrhythmia waveform recording. Refer to “Arrhythmia Recall Window” in Section 7.
FULL DISC:	Full disclosure recording. Refer to “Full Disclosure Window” in Section 7.

ALARM HISTORY:	Alarm history recording. Refer to “Alarm History Window” in Section 7.
ECG ANALYSIS WAVE:	ECG waveforms displayed on the ANALYSIS WAVE window of the 12 LEAD window are recorded. Refer to “12 LEAD ECG Window” in Section 5.
MANUAL:	Manual recording.
OCRG:	OCRG recording.

Recording Priority

If more than one recording mode is activated at the same time, only the highest priority mode is used.

Manually stopping recording by the record key | Manual recording | Alarm recording | Periodic recording

High ← Recording priority → Low

During alarm recording, if a higher priority alarm occurs, the present recording is cancelled and the higher priority alarm is recorded for 20 seconds.

During any type of recording, if a lower or equal priority alarm recording or any other type of recording occurs, that recording is not performed; only the current recording is performed.

Recording Sensitivity

The sensitivity of the waveforms recorded on the recording paper is the same as the sensitivity of the waveforms displayed on the screen.

To change the sensitivity, change the sensitivity setting on the parameter setting window as described in Sections 11 to 19.

Recording Speed

The recording speed can be set at RECORDING SWEEP SPEED on the RECORDING window.

Recording Related Message

The following messages and icons appear in the following conditions on the BSM-4101/4102/4103/4104 monitors.

When out of recording paper

When the recorder magazine is open

Recorded/Printed Data

The following data can be printed.

Printed Items	Example
Patient name	John Smith
Bed ID	BED-001
Date and time	2000/05/11 10:30
Reason for recording	TIMER, ALARM, etc.
Sensitivity	×2
Paper speed	25 mm/s
ECG related message	MAXIMUM*[1]
Heart rate (beats/min)	HR: 100
ECG lead	II
Number of VPCs	VPC: 10/min
ST level	–0.04 mV
Pulse rate (beats/min)	PR: 80
SpO_2 (%)	SpO_2: 98
NIBP: SYS/DIA (MEAN) (mmHg), measurement time	NIBP: 132/61 (80) mmHg 17:24
Respiration rate (resp/min)	RR: 14
CO_2 (mmHg)	CO_2: 40
IBP: SYS/DIA (MEAN) (mmHg)	P1: 132/61 (80) mmHg
Temperature (°C/°F)	T1: 36.4°C
FiO_2 (%)	FiO_2: 12
Arrhythmia name	COUPLET
Waveform annotation*[2]	N, V, P etc.

*[1] Selected setting for FILTERS on the ECG window is recorded. Refer to Section 11. When the “CHECK ELECTRODES” alarm occurs, “CHECK ELECTRODES” is recorded instead of the FILTERS setting.

*[2] Recorded when the recording mode is MANUAL, ALARM or RECALL and “ARRHYTHMIA ANALYSIS” on the ECG window is set to ON.

Changing the Recording Speed

Either 25 mm/s or 50 mm/s recording speed can be selected for recording with the optional recorder.

Recording speed and waveform sweep speed on the screen can be set individually.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “RECORDING” key to display the RECORDING window.

3. Select the speed by touching the speed key in the “RECORDING SWEEP SPEED” box.

4. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Recording Pattern

There are 7 recording patterns.

ECG (OFF):	Single lead ECG is recorded
ECG + SpO_2:	ECG and SpO_2 waveforms are recorded
ECG + RESP:	ECG and respiration waveforms are recorded
ECG + P1:	ECG and PRESS 1 waveforms are recorded
ECG + P2:	ECG and PRESS 2 waveforms are recorded
ECG + P3:	ECG and PRESS 3 waveforms are recorded
ECG + CO_2:	ECG and CO_2 waveforms are recorded

The selected recording pattern applies to all recording except recording on the review windows and CO window. The selected pattern is highlighted. ECG is the default setting.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “RECORDING” key to display the RECORDING window.

3. Select the parameter by touching the parameter key in the SECOND WAVE box. Select “OFF” when recording only ECG.

4. Press the HOME key on the front panel to return to the monitoring screen.

HOME

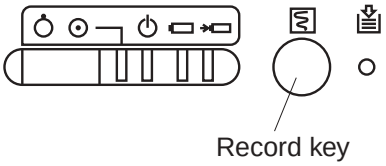
Manually Recording/Printing Waveforms

Recording Waveforms on the BSM-4101/4102/4103/4104 Monitors

Waveforms and data can be recorded manually on the BSM-4101/4102/4103/4104 monitors on the built-in recorder.

There are four settings:

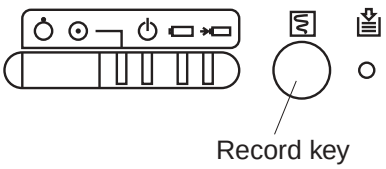
- Recording pattern: This setting determines which of the measured parameter waveforms is recorded. See the “Changing the Recording Pattern” section.
- Real-time or Delay mode: In DELAY mode, recording begins with the waveforms acquired 8 seconds before recording starts. In REAL TIME mode, recording begins with the waveforms being acquired when recording starts. To select real-time or delayed manual recording mode, refer to Section 3.
- Recording length: CONTINUOUS, 10, 20 or 30 seconds can be selected for the recording length on the SYSTEM SETUP screen. Refer to Section 3.
- Recording speed: The recording speed is set at RECORDING SWEEP SPEED on the RECORDING window.



1. If necessary, select the recording pattern on the RECORDING window. Refer to the “Changing the Recording Pattern” section.
2. To start recording, press the record key on the front panel.
3. To stop recording, press the record key again.

Recording Waveforms on the BSM-4111/4112/4113/4114 Monitors

When the BSM-4111/4112/4113/4114 bedside monitor is connected to a central monitor network with the QI-101P network card, waveforms and data can be recorded manually from the bedside monitor on the central monitor recorder. The waveforms are recorded with the recording length and recording pattern selected on the bedside monitor. When CONTINUOUS is selected for the recording length, 30 seconds is automatically selected.



1. If necessary, select the recording pattern on the RECORDING window. Refer to the “Changing the Recording Pattern” section.
2. To start recording, press the record key on the front panel.

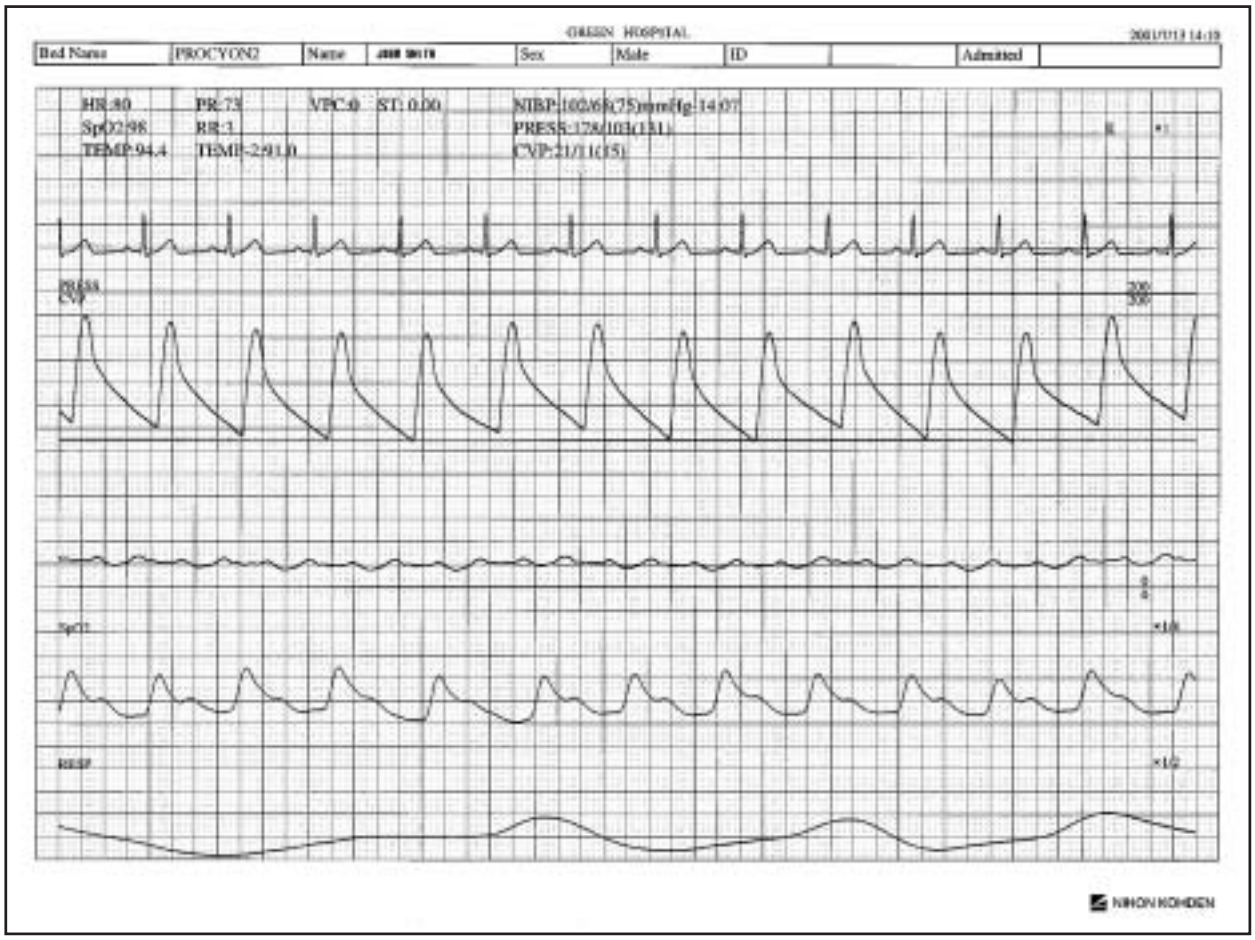
Manual Printing on the Network Printer

When the bedside monitor is connected to a network printer with the QI-111P network printer card, all monitoring waveforms and numeric data can be printed on the network printer. The waveforms from 7 seconds before to 3 seconds after the "PRINT" key at the upper left corner of the screen (function key) is pressed are printed.

To print, the print function must be assigned to one of the function keys in the upper left corner of the screen. Refer to "Assigning a Function to the Function Keys" in Section 4.

For details about printing on the network printer, refer to the "Printing on a Network Printer" section.

Printing Example



Setting Periodic Recording

You can select one of two types of recording data:

- ECG and a waveform selected on the RECORDING window and vital signs data
- OCRG

From the bedside monitor, automatic periodic recording cannot be performed on the central monitor recorder.

ECG and a waveform with vital signs data

A 10 second waveform can be automatically recorded at preset intervals of 30, 60, 120 minutes or a “free” interval that you can set to any length.

Recording starts at the nearest half-hour for 30 min interval, at the nearest hour for 60 or 120 min interval and at the next FREE interval for FREE recording.

For example, if you start automatic periodic recording at 9:20 with a 30 min interval, periodic recording will be performed at 9:30, 10:00, 10:30 and so on. If you start at 9:20 with a 120 min interval, periodic recording will be performed at 10:00, 12:00, 14:00 and so on. If you start at 9:20 with a FREE interval of 65 min, periodic recording will be performed at 10:25, 11:30, 12:35 and so on.

OCRG

The trendgraphs of HR, SpO_2 and RR and compressed respiration waveform are recorded. The OCRG is recorded every 5 minutes when 5(OCRG) is selected in the PERIODIC REC INTERVAL box on the RECORDING window, and every 15 minutes when 15(OCRG) is selected.

The OCRG recording has two pages. The first page contains HR and SpO_2 trendgraphs and the second page contains RR trendgraph and compressed respiration waveform.

Changing Settings for Automatic Periodic Recording

There are two settings:

- Periodic recording on/off: Recording interval must be selected on the RECORDING window to automatically record waveform and data at periodic interval. See below.
- FREE time interval: You can set the desired interval for automatic periodic recording on PERIODIC FREE on the SYSTEM SETUP screen. FREE selection is from 1 to 120 minutes (1 min/step). Default setting is 15 min. See Section 3, RECORD SETUP.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “RECORDING” key to display the RECORDING window.

3. Select the recording interval in the PERIODIC REC INTERVAL box. Select “OFF” when not performing periodic recording.

4. Press the HOME key on the front panel to return to the monitoring screen.

Printing on a Network Printer

When the bedside monitor is connected to a network printer with the optional QI-111P network printer card, the following printing is available.

- Real-time waveform printing: The waveforms from 7 seconds before to 3 seconds after the “PRINT” key at the upper left corner of the screen (function key) is pressed are printed.
- Printing data on the review windows: Displayed trendgraphs on the multi-parameter trendgraphs and single trendgraph when the “PRINT START” key on the TREND window is touched.

  Displayed list or stored list can be printed when the “PRINT START” key on the LIST window is touched.

  The displayed arrhythmia recall waveform is printed when the “PRINT START” key on the ARRHYTH RECALL window is touched.

  Displayed hemodynamics data can be printed when the “PRINT START” key on the HEMO LIST window is touched.

  Compressed or actual size full disclosure waveform selected by the cursor can be printed when the “PRINT START” key on the FULL DISC window is touched.
- Printing on the 12 LEAD window: 10 seconds of 12 lead ECG on the ANALYSIS WAVE window, 4 second ECG, rhythm waveform and analysis report on the ANALYSIS REPORT window and averaged waveforms on the AVERAGE WAVE window can be printed when the “PRINT START” key on the 12 LEAD window is touched.

To print on the network printer, the printer properties (IP address, printer name, paper size and color mode) must be set on the PRINTER SETUP screen of the SYSTEM SETUP screen. Refer to Section 3.

When printing a compressed full disclosure waveform, you can select the printing length on the PRINTER window of the RECORDING window. Refer to “Printing the Full Disclosure Waveform” in Section 7.

Section 9 Drug Window

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Drug Titration Initial Settings 9.2
Flow Rate Equations 9.3
Displaying the DRUG CALCULATE Window 9.4
Selecting the Drug 9.6
Assigning a Drug Name and Dosage Unit to DRUG A to D 9.7
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Drug Amount, Dosage and Step 9.10
Solution Amount, Flow Rate and Weight 9.11

General

The DRUG CALCULATE window is available only for the BSM-4103/4104/4113/4114 monitors.

On the DRUG CALCULATE window, you can calculate the flow rates and dosages for medication titrations. The flow rate is calculated from the below equation. The dosage can also be calculated when the flow rate is known.

$$\text{Flow rate} = \frac{\text{Dosage} \times \text{Patient Weight} \times \text{Solution Amount}}{\text{Drug Amount}}$$

There are three windows for the drug calculation. On the TITRATION TABLE window, you can see the table of the selected drug titration. The drug name and unit are selected on the DRUG NAME window. On the SETTING window, you can change drug amount, solution amount (BASE VOLUME), dosage (DOSE), flow rate (RATE), patient weight and dose step. The settings on the DRUG NAME and SETTING windows are used for the drug calculation and you can see the calculation result on the TITRATION TABLE window. The dosage and flow rate calculated from the setting on the SETTING window are highlighted in blue.

Drug name selected on the DRUG NAME window

Set on the SETTING window

Titration table

Records the titration table and the drug data on the left. When using the optional network printer card, the same data can be printed by touching the “PRINT START” key on the window.

Value calculated from the settings on the SETTING window

NOTE

- **When using the DRUG CALCULATE window for the first time after shipment or after settings are initialized, you must set the drug names and other settings.**
- **When the patient weight is changed on the PATIENT INFO window, the titration is automatically recalculated with the new weight.**

16 drugs and drug amount, solution amount, dosage and dose step for each drug are preset on the monitor. The dosage and flow rate are calculated from the equations listed in the “Flow Rate Equations” section. You can set four other drugs on the DRUG NAME window and change the settings on the SETTING window.

Drug Titration Initial Settings

Drug Name	Drug Amount	Solution Amount	Dosage	Step
AMINOPHYLLINE	500 mg	250 mL	0.50 mg/hr	0.10
BRETYLIUM	1000 mg	250 mL	1.00 mg/min	0.10
DOPAMINE	800 mg	500 mL	2.00 mcg/kg/min	0.10
DOBUTAMINE	500 mg	250 mL	2.50 mcg/kg/min	0.10
HEPARIN	25000 units	1000 mL	1000 units/hr	50
NITROGLYCERIN	50 mg	250 mL	0.50 mcg/kg/min	0.10
NITROPRUSSIDE	50 mg	250 mL	0.50 mcg/kg/min	0.10
EPINEPHRINE	1 mg	250 mL	1.00 mcg/min	0.10
LIDOCAINE	2000 mg	500 mL	2.00 mg/min	0.10
PROCAINAMIDE	2000 mg	500 mL	2.00 mg/min	0.10
INSULIN	100 units	500 mL	1.00 units/hr	0.10
LEVOPHED	4 mg	250 mL	2.00 mcg/min	0.10
ISOPROTERENOL	1 mg	250 mL	0.50 mcg/min	0.10
INOCOR	500 mg	500 mL	5.00 mcg/kg/min	0.10
STREPTOKINASE	1500000 IU	50 mL	30000 IU/hr	5000
TPA	100 mg	100 mL	60.00 mg/hr	0.10
DRUG A to D	mg	mL	mcg/kg/min	0.01

Flow Rate Equations

Dosage Unit	Drug Name	Equation
mg/hr	AMINOPHYLLINE TPA	$\text{Flow rate (mL/hr)} = \frac{\text{Dosage (mg/hr)} \times \text{Solution amount (mL)}}{\text{Drug amount (mg)}}$
mg/min	BRETYLIUM LIDOCAINE PROCAINAMIDE	$\text{Flow rate (mL/hr)} = \frac{\text{Dosage (mg/min)} \times \text{Solution amount (mL)} \times 60}{\text{Drug amount (mg)}}$
mcg/min	EPINEPHRINE LEVOPHED ISOPROTERENOL	$\text{Flow rate (mL/hr)} = \frac{\text{Dosage (mcg/min)} \times \text{Solution amount (mL)} \times 60}{\text{Drug amount (mg)} \times 1000}$
mcg/kg/min	DOPAMINE DOBUTAMINE NITROGLYCERINE NITROPRUSSIDE INOCOR	$\text{Flow rate (mL/hr)} = \frac{\text{Dosage (mcg/kg/min)} \times \text{Weight (kg)} \times \text{Solution amount (mL)} \times 60}{\text{Drug amount (mg)} \times 1000}$
units/hr	HEPARIN INSULIN	$\text{Flow rate (mL/hr)} = \frac{\text{Dosage (units/hr)} \times \text{Solution amount (mL)}}{\text{Drug amount (units)}}$
IU/hr	STREPTOKINASE	$\text{Flow rate (mL/hr)} = \frac{\text{Dosage (IU/hr)} \times \text{Solution amount (mL)}}{\text{Drug amount (IU)}}$

For DRUG A to D, when using the same dosage unit as above, the same equation is used. When using other units, refer to the table below.

Dosage Unit	Equation
mg/kg/min	$\text{Flow rate (mL/hr)} = \frac{\text{Dosage (mg/kg/min)} \times \text{Weight (kg)} \times \text{Solution amount (mL)} \times 60}{\text{Drug amount (mg)}}$
mg/kg/hr	$\text{Flow rate (mL/hr)} = \frac{\text{Dosage (mg/kg/hr)} \times \text{Weight (kg)} \times \text{Solution amount (mL)}}{\text{Drug amount (mg)}}$
mcg/hr	$\text{Flow rate (mL/hr)} = \frac{\text{Dosage (mcg/hr)} \times \text{Solution amount (mL)}}{\text{Drug amount (mg)} \times 1000}$
mcg/kg/hr	$\text{Flow rate (mL/hr)} = \frac{\text{Dosage (mcg/kg/hr)} \times \text{Weight (kg)} \times \text{Solution amount (mL)}}{\text{Drug amount (mg)} \times 1000}$

Displaying the DRUG CALCULATE Window

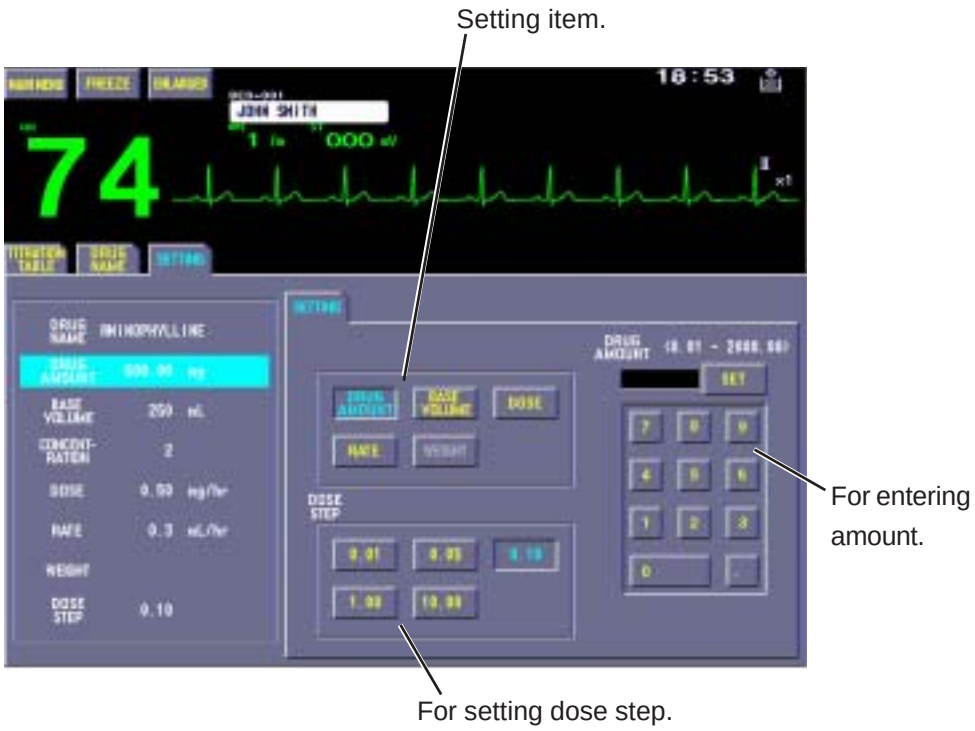
1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “DRUG CALCULATE” key. The DRUG CALCULATE window appears.

Touching the “RECORD” key records the titration table and the drug data on the left.

3. To display the DRUG NAME window, touch the “DRUG NAME” tab.

To display the SETTING window, touch the “SETTING” tab.

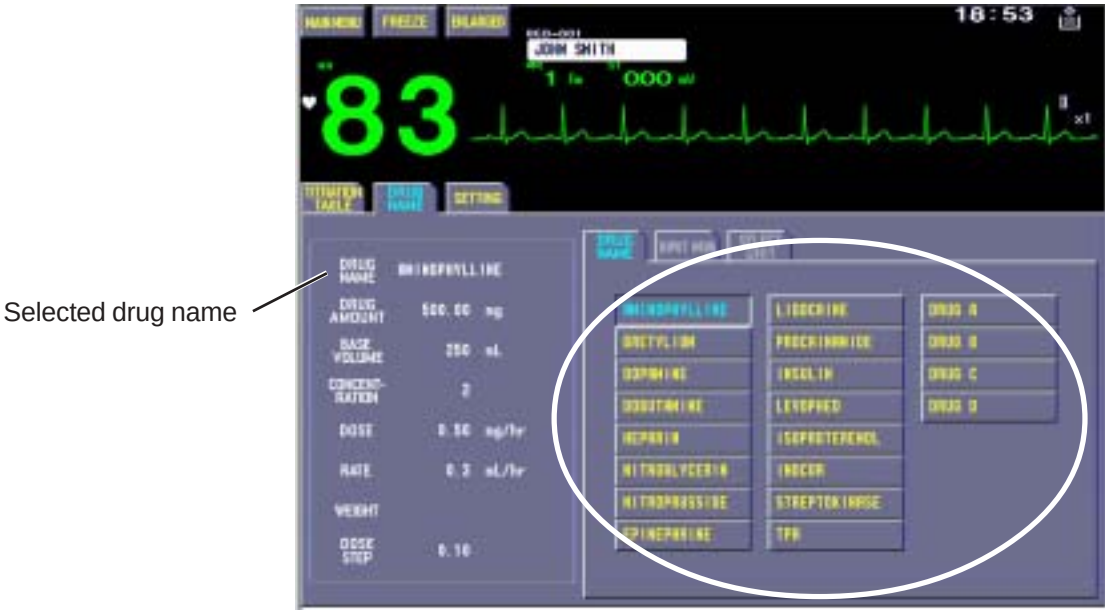


4. Press the HOME key on the front panel to return to the monitoring screen.

HOME

Selecting the Drug

1. Display the DRUG NAME window as described in the “Displaying the DRUG CALCULATE Window” section.



2. Select the drug by touching the drug name key. When the drug is selected, drug amount, solution amount (BASE VOLUME), dosage (DOSE) and step (DOSE STEP) set for that drug and concentration and flow rate which are automatically calculated appear on the window.

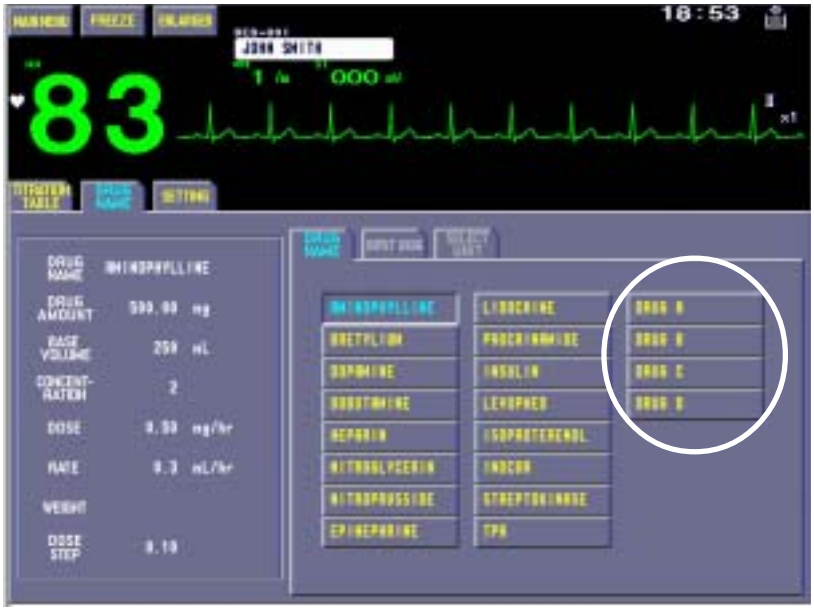
NOTE

- **DOPAMINE, DOBUTAMINE, NITROGLYCERIN, NITROPRUSSIDE and INOCOR need patient weight to calculate the flow rate. For these drugs, enter the patient weight on the PATIENT INFO window or the SETTING window of the DRUG TITRATION window.**
- **For the DRUG A to D, assign the drug name and set the unit on the DRUG NAME window and set the drug amount, solution amount, dosage and step on the SETTING window.**

Assigning a Drug Name and Dosage Unit to DRUG A to D

When using a drug other than the 16 preset drugs, you can assign a drug name and dosage unit to DRUG A to D. When the dosage unit is set, the flow rate unit is automatically set. When using this function, you must also set the drug amount, solution amount, dosage and step so that the dosage and flow rate can be calculated.

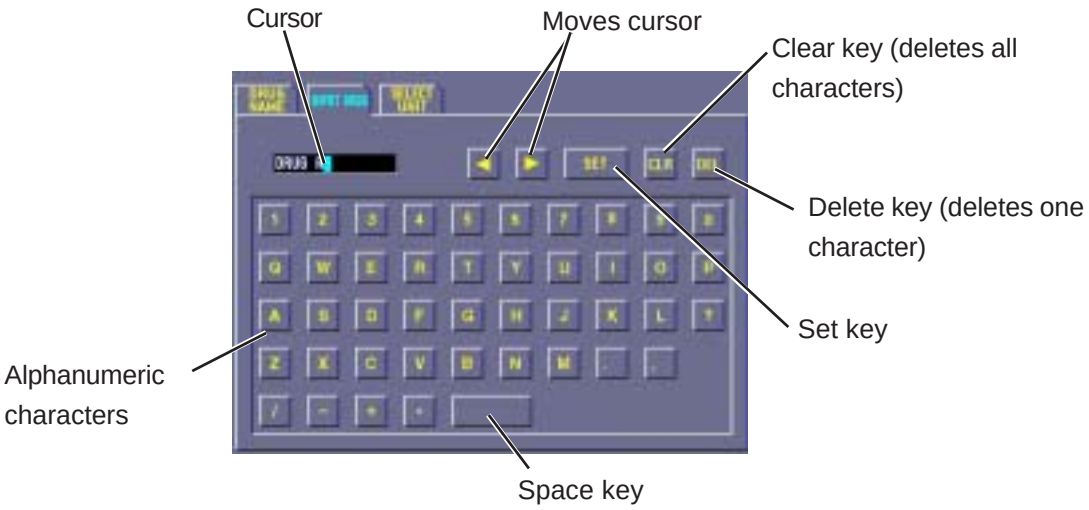
1. Display the DRUG NAME window as described in the “Displaying the DRUG CALCULATE Window” section.



2. Select DRUG A, B, C or D to assign a drug name.

3. Touch the “INPUT DRUG” tab. The keyboard for entering drug name appears.

4. Enter the drug name. Touch the SET key to register the entered name.



5. Touch the “SELECT UNIT” tab.

6. Select the unit. When the dosage unit is set, the flow rate unit is automatically set as follows.

Dosage Unit	Drug Amount Unit
mg/hr	mg
mg/min	
mg/kg/hr	
mg/kg/min	
mcg/hr	
mcg/min	
mcg/kg/hr	
mcg/kg/min	
units/hr	units
IU/hr	IU

Changing the Settings

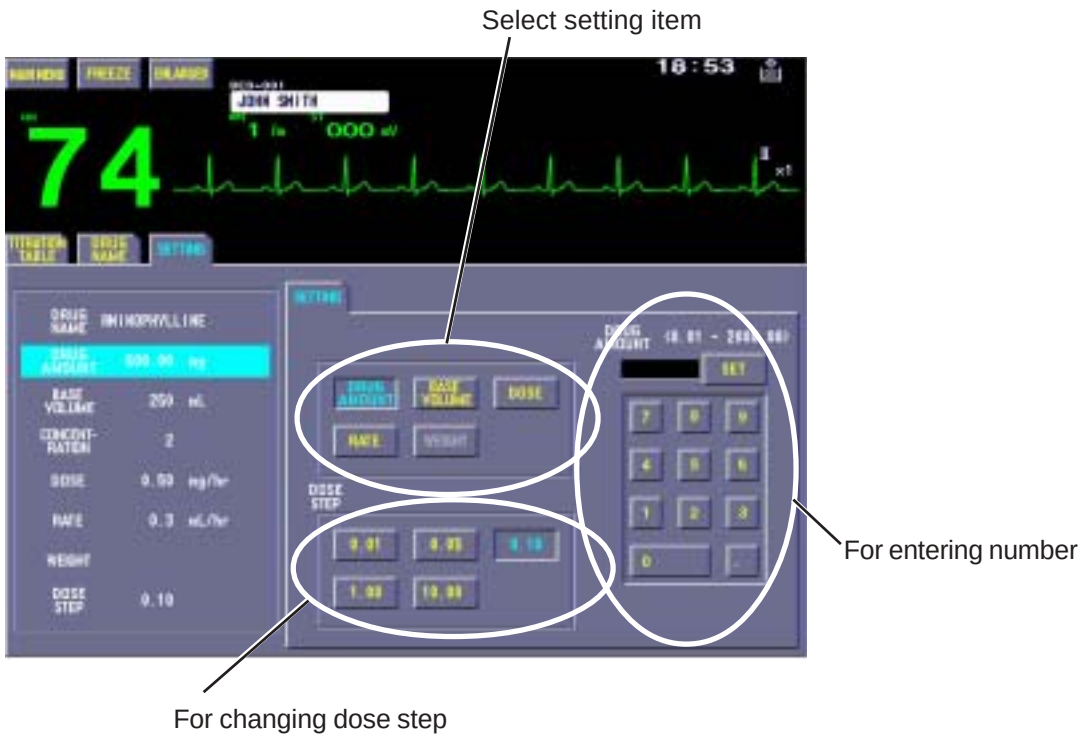
The following items can be changed for the drug calculation. When the settings are changed, the dosage and flow rate are automatically recalculated.

- Drug amount
- Solution amount
- Dosage
- Flow rate
- Weight
- Step

NOTE

- **Enter the data in the units displayed on the window.**
- **When using the drug which is assigned to DRUG A to D, you must set the unit on the DRUG NAME window before changing the setting on the SETTING window.**

1. Display the SETTING window as described in the “Displaying the DRUG CALCULATE Window” section.



2. Select the item you want to change the setting for by touching the item name key.

3. Change the setting.
   When changing the dose step, select the setting from the DOSE STEP box.

   When changing the value, use the numeric keys on the window, then touch the SET key.

Unit and Setting Range

Drug Amount, Dosage and Step

Drug Name	Drug Amount		Dosage		Step
	Unit	Setting Range	Unit	Setting Range	Setting Range
AMINOPHYLLINE	mg	0.01 to 2000	mg/hr	0.01 to 500	0.01, 0.05, 0.10, 1.00, 10.00
BRETYLIUM			mg/min		
DOPAMINE			mcg/kg/min		
DOBUTAMINE			mcg/kg/min		
HEPARIN	units	100 to 150000	units/hr	10 to 15000	10, 50, 100, 500
NITROGLYCERIN	mg	0.01 to 2000	mcg/kg/min	0.01 to 500	0.01, 0.05, 0.10, 1.00, 10.00
NITROPRUSSIDE			mcg/kg/min		
EPINEPHRINE			mcg/min		
LIDOCAINE			mg/min		
PROCAINAMIDE			mg/min		
INSULIN	units		units/hr		
LEVOPHED	mg		mcg/min		
ISOPROTERENOL			mcg/min		
INOCOR			mcg/kg/min		
STREPTOKINASE	IU	1000 to 1500000	IU/hr	1000 to 1500000	5000, 10000, 50000
TPA	mg	0.01 to 2000	mg/hr	0.01 to 500	0.01, 0.05, 0.10, 1.00, 10.00

For DRUG A to D

Dosage		Drug Amount		Step
Unit	Setting Range	Unit	Setting Range	Setting Range
mg/hr	0.01 to 500	mg	0.01 to 2000	0.01, 0.05, 0.10, 1.00, 10.00
mg/min				
mg/kg/hr				
mg/kg/min				
mcg/hr				
mcg/min				
mcg/kg/hr				
mcg/kg/min				
units/hr	10 to 15000	units	100 to 150000	10, 50, 100, 500
IU/hr	1000 to 1500000	IU	1000 to 1500000	5000, 10000, 50000

Solution Amount, Flow Rate and Weight

Item	Unit	Drug Amount Unit
Solution Amount	mL	1 to 1000
Flow Rate	mL/hr	0.1 to 600
Weight	kg	0 to 300

Section 10 Interbed Window

Registering Interbed Beds 10.2
Removing an Interbed Bed 10.3
Displaying the Interbed Bed Data 10.4
Displaying the Numeric Data of All Interbed Beds 10.6
Interbed Alarm 10.7
Setting Interbed Alarm On or Off 10.7

When the monitor is in a central monitor network, you can display waveforms, parameter data and alarm status of another bed in the network on the INTERBED window. This function lets the nursing staff check an alarm occurrence or condition of a remote patient without actually going to the alarmed or remote bed. With the interbed function, this monitor can receive data from any other selected monitor regardless of the settings on that monitor.

There is a PERSONAL DISP window for displaying numeric data and ECG and one waveform of one interbed bed, and a BED DISP window for displaying numeric data of all eight interbed beds which are registered as interbed beds.

Registering Interbed Beds

To view another bed, you must register the bed as an interbed bed. Only registered beds can be viewed. You can register up to 8 interbed beds. Any bed in the central monitor network can be registered as an interbed bed.

When registering an interbed bed, the power of the bedside monitor to be registered must be turned on.

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “INTERBED” key to display the INTERBED window.

3. Touch the “SELECT BED” tab to display the SELECT BED window.

4. Select the position to which you want to register the interbed bed in the INTERBED BEDS box.

5. Select the group from which you want to select the interbed bed from the GROUP box. The beds in the selected group are listed in the BEDS box.

6. Select the interbed bed from the BEDS box.

Removing an Interbed Bed

1. Select the interbed bed to be removed from the INTERBED BEDS box.

2. Touch the “UNMONITOR” key in the BEDS box.

Displaying the Interbed Bed Data

On the PERSONAL DISP window of the INTERBED window, heart rate and ECG waveform of the first trace are always displayed. Other numerical data and one waveform from the following list can be displayed. The parameters are listed in the display priority. Other parameters cannot be displayed.

Numeric Data

- Pulse rate
- VPC
- ST
- Respiration rate
- CO_2
- SpO_2
- NIBP
- T1
- T2
- Press1
- Press2
- Press3
- FiO_2

Waveform

- Respiration/CO_2
- SpO_2
- Press1
- Press2
- Press3

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “INTERBED” key to display the INTERBED window.

3. Touch the “PERSONAL DISP” tab to display the data of an interbed bed.

   To change beds, select the tab of a different bed.

   To change the second waveform, touch the numeric data of the parameter you want to display for the waveform.

Displaying the Numeric Data of All Interbed Beds

The numeric data of all registered interbed beds can be displayed on the BED DISP window. The parameters that can be displayed are: heart rate, SpO_2, respiration rate, CO_2 and either NIBP or IBP with the highest priority label.

1. Press the MENU key on the front panel. The MENU window appears.

2. Touch the “INTERBED” key to display the INTERBED window.

3. Touch the “BED DISP” tab to display the numeric data of all interbed beds.

Interbed Alarm

When an alarm occurs on an interbed bed, an “ALARM bed name” message appears at the top left of the monitoring screen. This interbed alarm message does not indicate the type of alarm. The INTERBED BED DISP window can be automatically displayed when an alarm occurs and AUTO INTERBED DISPLAY is set to on.

Only one alarm message and interbed ID can be displayed at a time on the monitoring screen. When more than one interbed alarm occurs, the alarm message appears with all alarming interbed IDs alternately.

On the INTERBED window, the type of alarm is indicated. The bed ID of the alarmed bed is highlighted.

The interbed alarm can be set to on or off. When set to ON, the highlighted “ALARM bed name” message is displayed and there are three “bing” sounds on an interbed alarm occurrence. When set to OFF, only the non-highlighted message is displayed.

You can also silence the interbed alarm by touching the key on the PERSONAL DISP window of the INTERBED window.

Setting Interbed Alarm On or Off

1. Press the MENU key on the front panel. The MENU window opens.

2. Touch the “INTERBED” key to display the INTERBED window.

3. Touch the “SETTING” tab to display the SETTING window.

4. Select interbed alarm “ON” or “OFF” in the INTERBED ALARM box.

   Select auto interbed display “ON” or “OFF” in the AUTO INTERBED DISPLAY box. When this is set to ON, the BED DISP window is automatically displayed on an alarm occurrence when the monitoring screen is displayed.

5. Press the HOME key on the front panel to return to the monitoring screen.

Section 11 ECG Monitoring

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General

ECG is monitored by attaching disposable electrodes to the patient and using the ECG/RESP socket on the monitor. Arrhythmia can be analyzed and ST level is also measured. On the BSM-4101/4102/4111/4112 monitors, one lead can be monitored. On the BSM-4103/4104/4113/4114 monitors, 12 leads can be monitored when using 10 electrodes and 8 leads can be monitored when using 6 electrodes. When 12 leads are monitored, 12 lead ECG interpretation can be performed on the 12 LEAD window. Refer to Section 5.

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment*

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. If this occurs, disconnect the monitor or diagnostic equipment from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden distributor.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the patient, resulting in an elevated pacing rate.

  For more information, see the FDA web site.
  http://www.fda.gov/cdrh/safety.html

Using the Output Signal from the ECG/BP OUT Socket

WARNING

When using the output signal from the module as the synchronization signal for other equipment such as IABP (intra-aortic balloon pump) or defibrillator:

- **Set the timing of the other equipment by checking the waveform on the monitoring screen.**
- **Check the condition of the bedside monitor at all times. The output signal may become unstable.**
- **The hum filter is always set to on for the ECG output. ECG output differs from the ECG on the monitor screen regardless of the filter setting.**
- **Check that the delay time of the output signal (heart rate trigger 64 ms maximum) is within the range of the connected equipment.**
- **Do not use the heart rate trigger as the synchronization signal for a defibrillator.**

NOTE

The output signal from the ECG/BP OUT socket may become unstable in the following conditions.

- **Electrode is dry or detached.**
- **Electrode lead is damaged or disconnected from the electrode.**
- **Electrode lead is pulled.**
- **AC interference or EMG noise superimposed.**
- **Air bubbles or blood clog in the circuit for monitoring IBP.**
- **Cord or cable is disconnected or damaged.**

Preparing for ECG Monitoring

Preparation Flowchart

1. Select the electrode lead. To perform 12 lead ECG interpretation, ECG must be monitored with ten leads.

2. Connect the electrode lead to the ECG connection cord and ECG connection cord to the ECG/RESP socket on the monitor.

3. Attach the disposable electrodes to the patient and attach the electrode lead to the electrodes.

4. Monitoring starts. Set necessary settings.

   For handling accessories after use, refer to Section 21.

Selecting a Lead

NOTE

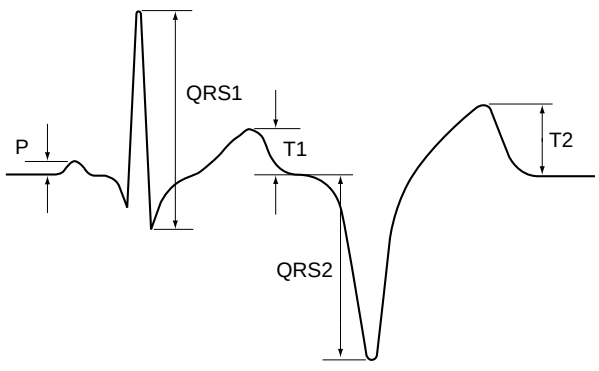
Follow the physician's instructions for lead position when available.

It is generally considered that Lead II and Lead V1 are suitable for arrhythmia monitoring and that Lead V4 and Lead V5 are suitable for myocardial ischemia monitoring.

Some types of ECGs are difficult for automatic analysis, and heart rate or arrhythmia detection level is not accurate for some patients. In these cases, use the following procedure to find the appropriate lead for automatic analysis.

1. Measure the patient's ECG with the standard 12 ECG leads using an ECG instrument.

2. Select the optimum lead according to the following guidelines:
   1) Select the lead with the highest QRS wave amplitude and least difference in amplitude compared with a VPC or pacing pulse.
      $0.5 \leq QRS1/QRS2 \leq 2$
   2) Select the lead with less than 0.2 mV amplitude of the P-wave.
      $P \leq 0.2$ mV
   3) Select the lead with a T-wave amplitude which is less than one-third of the QRS wave.
      $T1 \leq 1/3QRS1,\ T2 \leq 1/3QRS2$



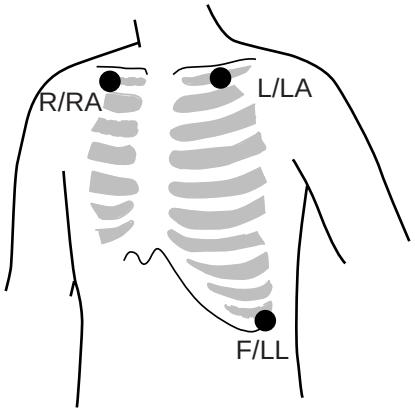
Number of Electrodes and Measuring Leads

The leads which can be monitored differ according to the type of electrode lead and number of electrodes used. This monitor automatically identifies the number of electrodes attached to the patient.

No. of Electrodes	Lead	Features
3	I, II, III	Can measure at the thoracic wall.
6	I, II, III, aVR, aVL, aVF, Va, Vb	Similar to the standard 12 lead.
10	I, II, III, aVR, aVL, aVF, V1 to V6	Standard 12 lead.

Electrode Position

3 Electrode Leads

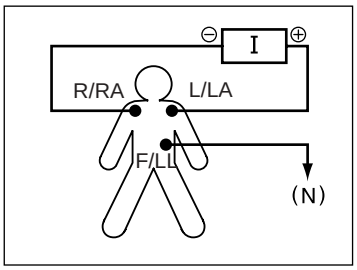


Electrode Position

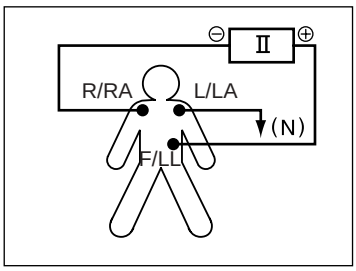
Symbol	Lead Color (Clip Color)	Electrode Position
R RA	Red (Red-beige) White (White-beige)	Right infraclavicular fossa
L LA	Yellow (Yellow-beige) Black (Black-beige)	Left infraclavicular fossa
F LL	Green (Green-beige) Red (Red-beige)	Lowest rib on the left anterior axillary line

Lead Connection

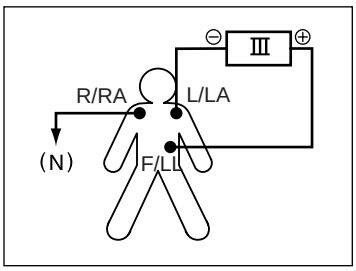
Lead I

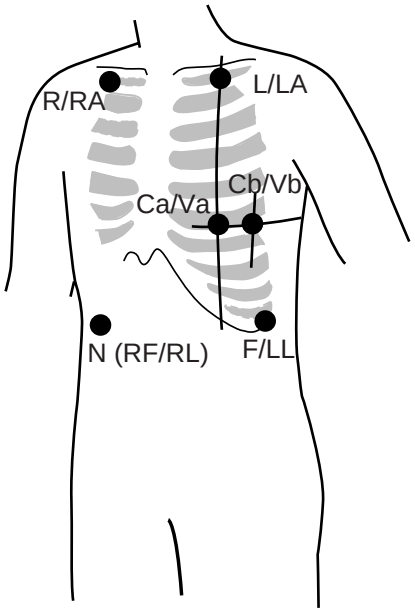


Lead II



Lead III





6 Electrode Leads

Electrode Position

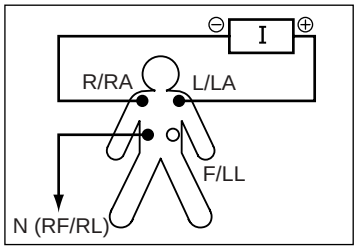
The 6-electrode method with lead II and lead V5 is effective for monitoring myocardial ischemia. You can improve monitoring accuracy considerably by adding lead V4 to this combination. Ca and Cb (Va and Vb) can be at any position of the standard 12 leads C1 to C6 (V1 to V6), but C4 and C5 (V4 and V5) are most appropriate for myocardial ischemic monitoring.

Symbol	Lead Color (Clip Color)	Electrode Position
R RA	Red (Red-beige) White (White-beige)	Right infraclavicular fossa
L LA	Yellow (Yellow-beige) Black (Black-beige)	Left infraclavicular fossa
F LL	Green (Green-beige) Red (Red-beige)	Lowest rib on the left anterior axillary line
N (RF) N (RL)	Black (Black-beige) Green (Green-beige)	Right anterior axillary line at the same level as F.
Ca Va	White (Brown-white) Brown (Blue-brown)	Fifth intercostal space on the left midclavicular line. (C4 position of standard 12 leads)
Cb Vb	White (Black-white) Brown (Orange-brown)	Left anterior axillary line at the same level as Ca. (C5 position of standard 12 leads)

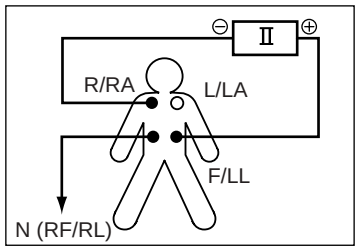
Lead Position

Standard limb leads

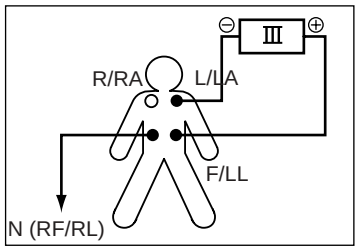
Lead I



Lead II

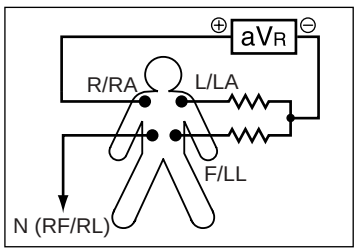


Lead III

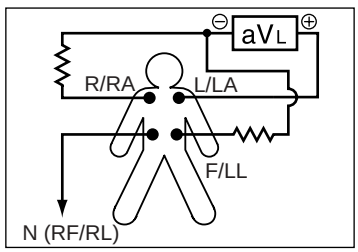


Monopolar limb leads

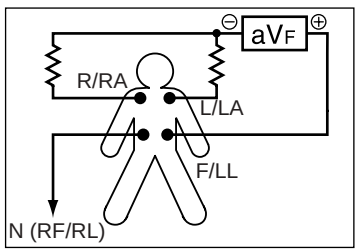
aV_R lead



aV_L lead

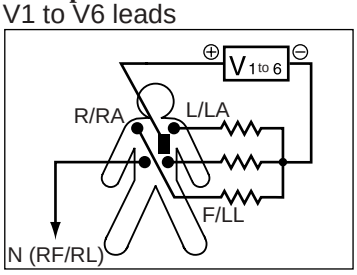


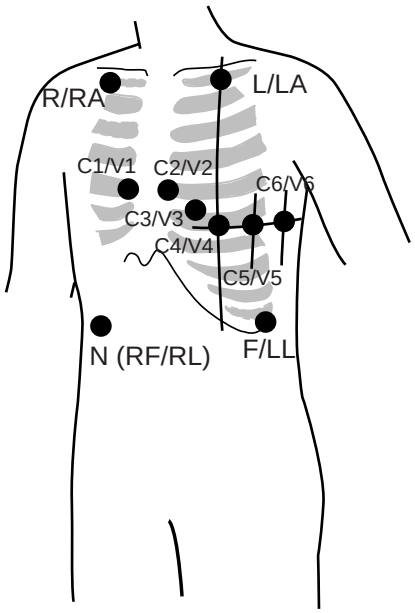
aV_F lead



Monopolar chest leads

V1 to V6 leads





10 Electrode Leads

Electrode Position

Symbol	Lead Color (Clip Color)	Electrode Position
R RA	Red (Red-beige) White (White-beige)	Right infraclavicular fossa
L LA	Yellow (Yellow-beige) Black (Black-beige)	Left infraclavicular fossa
F LL	Green (Green-beige) Red (Red-beige)	Lowest rib on the left anterior axillary line
N (RF) N (RL)	Black (Black-beige) Green (Green-beige)	Right anterior axillary line at the same level as F.
C1 V1	White (Red-white) Brown (Red-brown)	Fourth intercostal space at the right border of the sternum.
C2 V2	White (Yellow-white) Brown (Yellow-brown)	Fourth intercostal space at the left border of the sternum.
C3 V3	White (Green-white) Brown (Green-brown)	Halfway between C2 and C4.
C4 V4	White (Brown-white) Brown (Blue-brown)	Fifth intercostal space on the left midclavicular line.
C5 V5	White (Black-white) Brown (Orange-brown)	Left anterior axillary line at the same level as C4.
C6 V6	White (Purple-white) Brown (Purple-brown)	Left midaxillary line at the same level as C4.

Lead Connection

The lead connection is the same as the 6 electrode lead.

Selecting Electrodes and Lead

Select the appropriate electrodes and lead according to the purpose. The electrodes are local purchase.

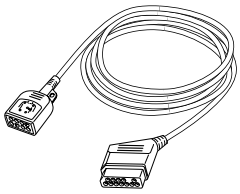
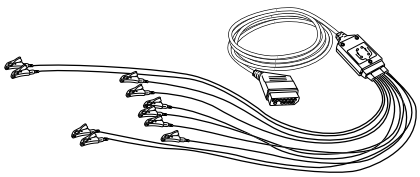
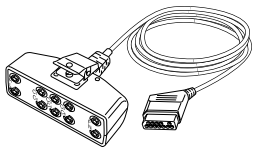
WARNING

When using a defibrillator together with the monitor, use Ag/AgCl electrodes. Other types of electrodes, stainless steel in particular, will adversely affect the ECG waveform by slowing the baseline recovery on the monitor and result in no monitoring immediately following defibrillation.

CAUTION

- **Use only Nihon Kohden products and specified parts and accessories. When other type of electrodes are used, the "CHECK ELECTRODES" message may be displayed and monitoring may stop.**
- **Do not reuse disposable electrodes.**

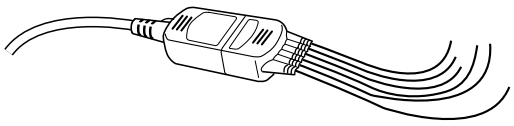
Types of Leads and Connection Cords

<table>
<tr><th>No. of Electrodes</th><th>Electrode Lead</th><th>ECG Connection Cord</th></tr>
<tr><td>3
(I, II, III)</td><td>BR-903PA (AHA)
BR-913PA (AHA) (Snap type)
 </td><td rowspan="2">JC-906PA (AHA)
  </td></tr>
<tr><td>6
(I, II, III, aVR, aVL, aVF, 2 from V1 to V6)</td><td>BR-906PA (AHA)
BR-916PA (AHA) (Snap type)
 </td></tr>
<tr><td rowspan="2">10
(I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6)</td><td colspan="2">ECG Patient Cable BJ-900PA (AHA)
  </td></tr>
<tr><td>—————</td><td>JC-900PA (AHA)
  </td></tr>
</table>

Connecting Cables and Attaching Disposable Electrodes

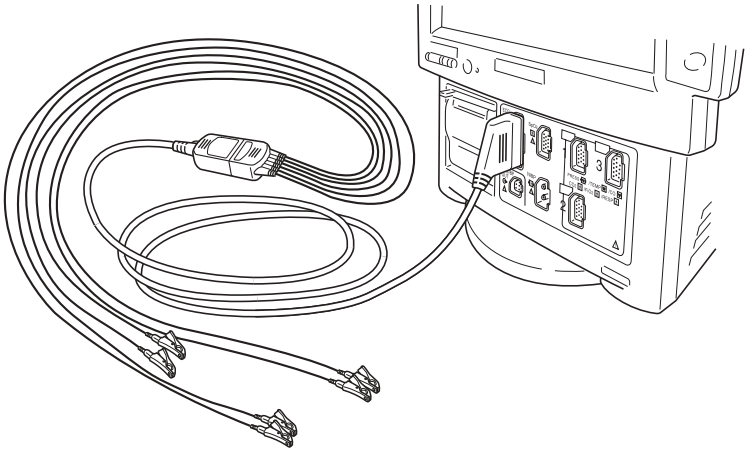
Connecting the Electrode Cable to the Monitor

1. Connect the electrode lead and ECG connection cord so that their white panels face the same side.



2. Connect the ECG connection cord to the ECG/RESP socket on the monitor.

When connecting the 6-electrode lead



Attaching Disposable Electrodes to the Patient

NOTE

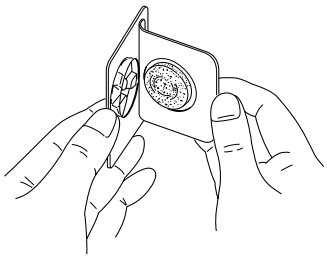
- **To maintain good contact between the electrode and skin, check that the paste of the disposable electrode is not dry.**
- **When contact of the disposable electrode becomes poor, replace the electrode with a new one immediately. Otherwise, contact impedance between the skin and electrode increases and the correct ECG cannot be obtained.**
- **If the contact is bad before the expiration date on the package, replace the electrode with a new one.**

1. Shave excess hair. With a piece of cotton pad moistened with alcohol, clean the patient's skin where the electrodes should be mounted. Avoid wrinkled or uneven skin areas. Wipe off the alcohol with a dry cotton pad.

NOTE

To obtain a stable ECG waveform rub the skin with "skinPure" skin preparation gel or tincture of Benzoin.

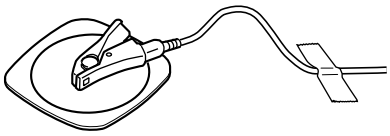
2. Open the electrode package and take out the electrode.



3. Remove the backing paper from the electrode. Be careful not to touch the adhesive side.

4. Attach the disposable electrode to the previously cleaned skin. Avoid wrinkled and uneven skin areas.

5. Clip the electrode lead which is connected to the monitor onto the electrode.



6. Fasten the electrode lead to the skin with surgical tape with an extra length of wire between the tape and the electrode. This prevents body movement from moving the electrode lead.

Monitoring ECG

When electrodes are attached to the patient and cables are connected properly, ECG appears on the screen.

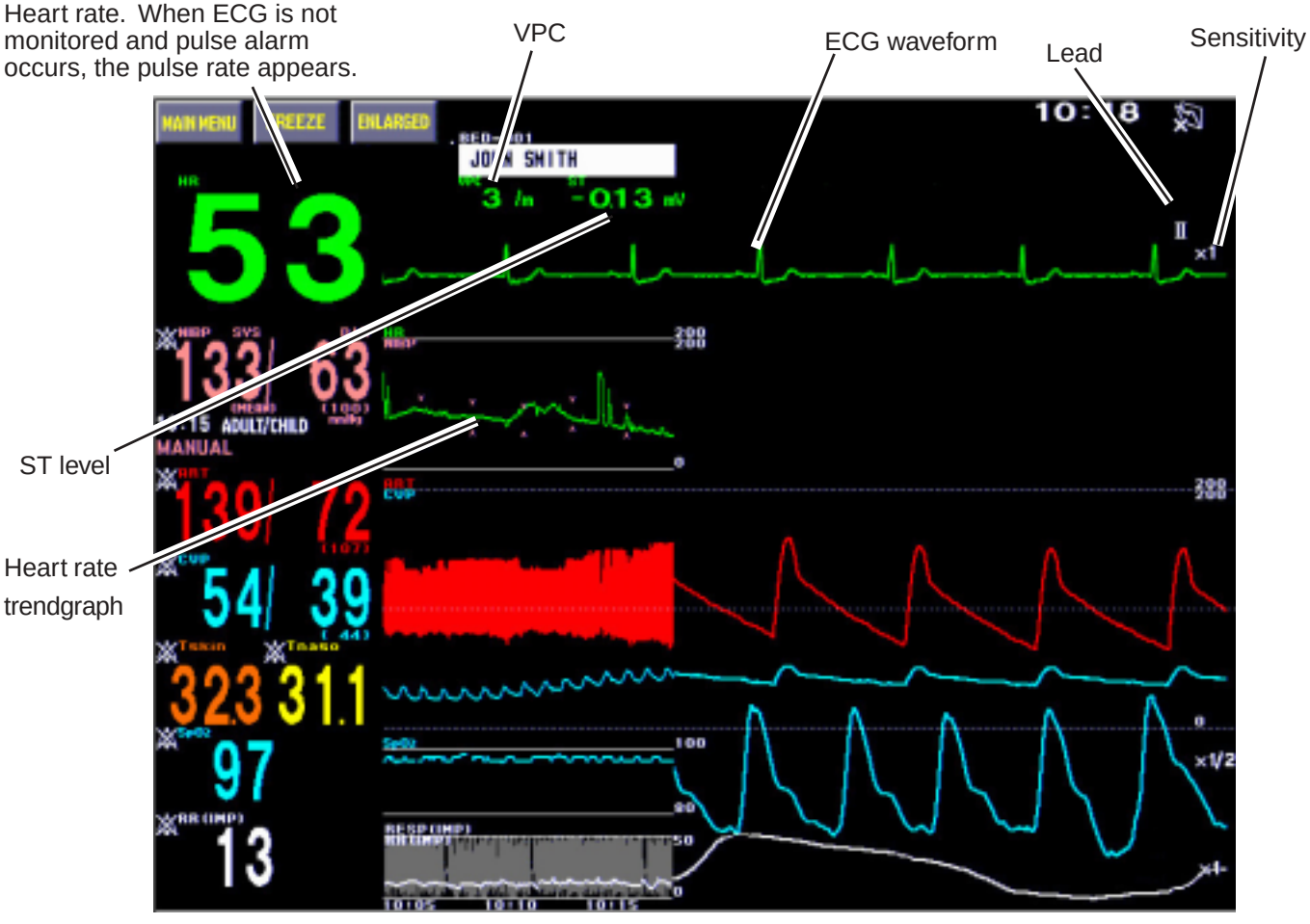
One lead appears on the monitoring screen. On the BSM-4103/4104/4113/4114 monitors, you can display eight leads on the 12 LEAD window when monitoring with six electrodes and twelve leads when monitoring with ten electrodes. To perform 12 lead ECG interpretation, ECG must be monitored with ten electrodes.

CAUTION

- **When the "CHECK ELECTRODES" message is displayed, ECG cannot be monitored and the ECG alarm does not function. Check the electrode and if necessary, replace it with a new one.**
- **At the start of ECG monitoring, check that the dominant QRS is appropriate. Otherwise arrhythmia monitoring may be inaccurate.**

For error messages and monitoring problems, refer to Section 20.

ECG Information on the Monitoring Screen

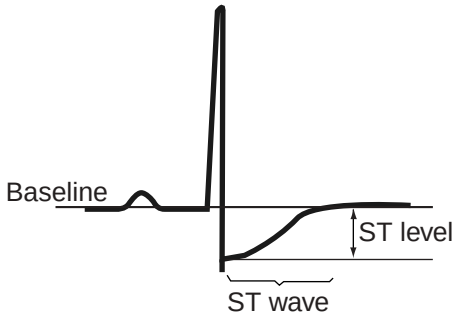


Measuring ST Level

The ST level is the amplitude between the baseline and ST wave. The ECG waveform is averaged for 15 seconds to remove artifacts. The baseline and the ST wave are detected from the averaged ECG, and the ST level is measured.

NOTE

If there are too many arrhythmias or noise superimposed on the ECG, or the heart rate is below 32, ST level measurement may not be performed and ST level is not displayed on the screen.



You can change the ISO point and ST point for ST level measurement on the ST window. This change does not apply to previously acquired data. Refer to “ST Level Recall Window” in Section 7.

Monitoring Arrhythmia

The following functions are available for arrhythmia monitoring.

- Arrhythmia alarm indication (alarm sound, screen message and alarm indicator lamp). See Section 6.
- Arrhythmia waveform storage. See Section 7.
- Arrhythmia waveform recording. See Section 7.
- VPC rate/min display and trendgraph. See Sections 5 and 7.

WARNING

ARRHYTHMIA ANALYSIS on the ECG OTHER SETTING window must be set to ON when arrhythmia monitoring is necessary. If arrhythmia detection is turned OFF, there is no arrhythmia alarms. When arrhythmia detection is set to off, the “ARRHYTHMIA ANALYSIS OFF” message appears on the screen.

When arrhythmia detection is set to on, arrhythmia detection starts as soon as the ECG monitoring starts. The dominant QRS displayed on the ECG window is used for analyzing arrhythmia. If the following points of a QRS do not match with the dominant QRS, that QRS is recognized as an arrhythmia.

- RR interval
- QRS width
- QRS amplitude
- QRS polarity

CAUTION

If there is any doubt about the arrhythmia analysis, make the monitor relearn the patient's VPC and check that the dominant QRS is appropriate. Otherwise, arrhythmia monitoring may not be accurate.

The following classification messages are displayed on the screen.

Arrhythmia Analysis Classification Messages

Alarm Name	Description	Displayed Time (s)
ASYSTOLE	Longer than 3 to 10 seconds (selectable) with no QRS complex.	30
VF	Ventricular fibrillation.	
VT	Ventricular tachycardia. 9 or more consecutive VPCs.	
VPC RUN	VPC short run. 3 to 8 (selectable) consecutive VPCs.	20
COUPLET	VPC couplet (paired VPCs). 2 consecutive VPCs.	
EARLY VPC	Early VPC. VPC with a time interval from the preceding normal QRS complex of less than approx. one-third of the normal R-R interval.	
BIGEMINY	Ventricular bigeminy. 3 or more consecutive pairs of VPC and normal QRS.	10
FREQ VPC	Frequent VPCs. VPC rate (VPCs/min) reaching or exceeding the preset limit of 1 to 50 VPCs/min (selectable).	
TACHYCARDIA	Tachycardia. Exceeding the upper heart rate limit.	
BRADYCARDIA	Bradycardia. Dropping below the lower heart rate limit.	

Turning Arrhythmia Analysis On/Off

WARNING

This setting must be set to ON when arrhythmia analysis is necessary. If arrhythmia analysis is turned off, there are no arrhythmia alarms.

When arrhythmia monitoring is necessary, select ON.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "ECG" key. The ECG window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “ON” or “OFF” key in the ARRHYTHMIA ANALYSIS box to turn arrhythmia analysis on or off.

5. Press the HOME key on the front panel to return to a monitoring screen.

Learning the ECG Waveform for Arrhythmia Detection (VPC Learning)

The monitor automatically detects and classifies arrhythmia waveforms when arrhythmia detection is set to on. To do this, the monitor compares each beat of the real-time ECG waveform to a reference ECG waveform (dominant QRS).

The monitor automatically samples this reference waveform when ECG monitoring begins, when the monitoring lead is changed, when the “CHECK ELECTRODE” alarm message is resolved and when the patient’s dominant ECG waveform changes. Sampling the reference waveform is called “Learning”.

Learning takes about 10 seconds. During learning, a “LEARNING” message is displayed on the screen. After learning, the dominant QRS is replaced with the new one and the monitor resumes analyzing the ECG waveforms.

During learning, ASYSTOLE, BRADYCARDIA and TACHYCARDIA alarms do not function.

You can make the monitor “relearn” the reference ECG waveform at any time, for example, when the automatic VPC classification is questionable, and change the dominant QRS.

CAUTION

If there is any doubt about the arrhythmia analysis, make the monitor relearn the patient’s VPC. Otherwise, an important arrhythmia may be overlooked.

When the QRS wave or RR interval changes too frequently, it becomes difficult for the monitor to distinguish between the normal ECG and arrhythmia. The monitor uses the pattern matching and multi template matching for analyzing arrhythmia to solve this problem. However, when the patient QRS changes rapidly, check that the appropriate dominant QRS is used for arrhythmia analysis.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Touch the “LEARN ECG” key on the ECG window. The monitor learns the reference ECG waveform and the dominant QRS is renewed.

4. Check that the dominant QRS is appropriate for arrhythmia analysis.

Changing the Dominant QRS

The monitor detects QRS of the monitoring ECG and classifies them into templates. The monitor uses the most typical QRS, called dominant QRS, for analyzing arrhythmia. The four most typical templates are displayed as NORMAL BEATS and the other four QRS which do not match the typical templates are recognized as arrhythmia and displayed as OTHER BEATS on the TEMPLATE window of the ECG window. You can change the dominant QRS with other templates. Whenever ECG is learned or relearned, the dominant QRS and templates are refreshed.

If there is any doubt about the arrhythmia analysis, make the monitor relearn the patient’s VPC and check the dominant QRS.

If there is a normal QRS recognized as OTHER BEATS, such as when monitoring a pacemaker patient, you can move that QRS to the NORMAL BEATS so that the monitor will recognize it as a normal QRS and not as an arrhythmia.

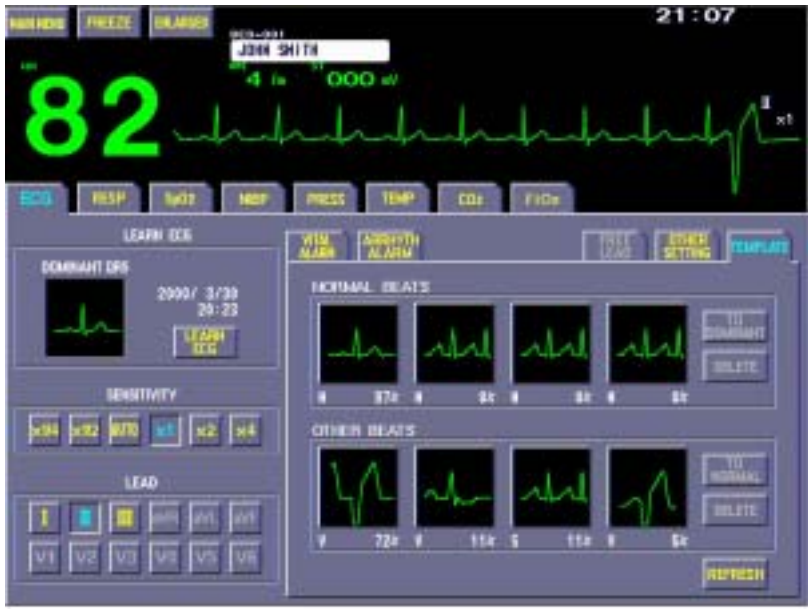
CAUTION

Changing the dominant QRS must be performed under the physician’s instructions.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Touch the “TEMPLATE” tab on the ECG window.



4. To use another QRS in the NORMAL BEATS as the dominant QRS:
   i) Select the QRS from the NORMAL BEATS box.

   ii) Touch the “TO DOMINANT” key in the NORMAL BEATS box. The message appears confirming the change of dominant QRS.

   iii) Touch the “YES” key to change the dominant QRS to the selected QRS.

   To move a QRS from the OTHER BEATS to NORMAL BEATS, select the QRS in the OTHER BEATS box and touch the “TO NORMAL” key.

   To delete a QRS from NORMAL BEATS or OTHER BEATS, select the QRS and touch the “DELETE” key.

   To refresh the setting, touch the “REFRESH” key.

5. Press the HOME key on the front panel to return to a monitoring screen.

Noise Detection and Display

When EMG or body movement noise is superimposed on the ECG waveform during ECG monitoring, a “NOISE” message appears on the screen.

Detached Electrode Detection and Display

When an electrode or electrode lead is detached during ECG monitoring, a highlighted “CHECK ELECTRODES” message appears with a “bong” sounding every 20 seconds and yellow alarm lamp lit.

When monitoring with 6 or 10 electrodes and AUTO LEAD CHANGE on the ECG OTHER SETTING window is set to ON, and the “CHECK ELECTRODES” message is displayed for more than 5 seconds, the lead on the monitoring screen is automatically changed to a stable lead.

The correct ECG waveform does not appear on the screen while the “CHECK ELECTRODES” message is displayed. Check the electrodes.

Changing ECG Settings

Change settings on the ECG window. The following settings can be changed for ECG monitoring.

- Monitoring lead
- ECG sensitivity
- Heart rate and ST alarm limits
- Arrhythmia alarm setting
- Number of electrodes
- Sync source
- Arrhythmia analysis on/off. Refer to the “Monitoring Arrhythmia” section.
- Filter mode
- Heart rate display mode
- Pacing spike detection and pacing mark display on/off
- Auto lead change on/off when electrode is detached
- Learn ECG. Refer to the “Monitoring Arrhythmia” section.
- Change dominant QRS. Refer to the “Monitoring Arrhythmia” section.

The following items can be set on the SYSTEM SETUP screen. Refer to Section 3.

- Hum filter on or off for monitoring 12 leads
- ECG electrode lead type (IEC or AHA)
- ST unit (mV or mm)

Changing the Monitoring Lead

One lead can be monitored on the monitoring screen.

No. of Electrodes	Lead
3	I, II, III
6	I, II, III, aVR, aVL, aVF, Va, Vb
10	I, II, III, aVR, aVL, aVF, V1 to V6

When monitoring with 6 or 10 electrodes, the lead can be automatically changed to a stable lead when there is an electrode detachment or the “CHECK ELECTRODES” message is displayed for more than 5 seconds. Refer to the “Auto Lead Change On or Off” section.

Changing a Lead

NOTE

When the NUMBER OF ELECTRODES setting is changed, the lead setting automatically changes to II. Change the number of electrodes setting before changing the lead.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Select the lead by touching the desired lead key in the LEAD box.

HOME

4. Press the HOME key on the front panel to return to the monitoring screen.

Assigning Va and Vb (Ca and Cb) Leads when Monitoring with 6 Electrodes

You can assign the leads for Va and Vb when using 6 electrodes. After assigning the Va and Vb leads, select the monitoring lead.

1. Display the ECG window.

2. Touch the “FREE LEAD” tab to display the FREE LEAD window. The number of electrodes must be set to 6 on the ECG OTHER SETTING window.

3. Select the lead by touching the desired lead key.

4. Press the HOME key on the front panel to return to the monitoring screen.

Auto Lead Change On or Off

When monitoring with 6 or 10 electrodes and AUTO LEAD CHANGE on the ECG OTHER SETTING window is set to ON, the lead on the monitoring screen can be automatically changed to a stable lead when there is an electrode detachment or the “CHECK ELECTRODES” message is displayed for more than 5 seconds on the screen. While the “AUTO LEAD CHANGE” message is displayed, the “CHECK ELECTRODES” message is not displayed.

1. Display the ECG window.

2. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

3. Touch the “ON” or “OFF” key in the AUTO LEAD CHANGE box to select on or off.

4. Press the HOME key on the front panel to return to the monitoring screen.

Changing the ECG Sensitivity

The sensitivity determines the size of the waveform on both the screen and recording paper.

The sensitivity can be set manually or automatically. When you select AUTO sensitivity, the sensitivity is automatically determined according to the average QRS amplitude of the previous 16 beats. When sensitivity is set automatically, “AG” (auto gain) appears beside the sensitivity on the screen. When there is noise, AUTO sensitivity is not possible.

QRS Wave Amplitude	Sensitivity
< 5 mm	× 4
< 10 mm	× 2
< 20 mm	× 1
< 30 mm	× 1/2
≥ 30 mm	× 1/4

For stable QRS detection, select the sensitivity so that the amplitude of the QRS is larger than 1 cm.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Select the sensitivity by touching the desired sensitivity in the SENSITIVITY box.

4. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Heart Rate or Pulse Rate and ST Alarm Limits

CAUTION

When the upper or lower alarm limit is turned off, there will be no upper or lower alarm for that limit.

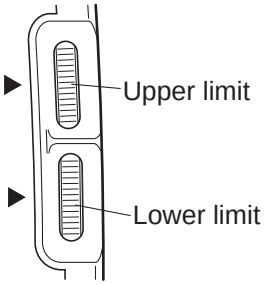
You can set the upper and lower heart rate and ST alarm limits on this window. Other alarm items must be set on the VITAL ALARM window. You can set all alarms, including the upper and lower heart rate and ST alarm limits, on the VITAL ALARM window (See Section 6).

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Touch the HR/PR alarm setting bar to change the HR/PR alarm setting.

   Touch the ST alarm setting bar to change the ST alarm setting.



4. Use the function dials on the front panel to change settings.

   Or,

   1) Touch the upper limit box to set the upper limit or touch the lower limit box to set the lower limit.

   2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   Or,

   Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum or the lower limit is set to a value below the minimum, the alarm is set to OFF.

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Arrhythmia Alarm Setting

WARNING

For arrhythmia monitoring, set ARRHYTHMIA ANALYSIS on the ECG OTHER SETTING window to ON. Otherwise, there is no sound or indication for arrhythmia alarms.

CAUTION

When the alarm is turned OFF for an arrhythmia, there will be no alarm for that arrhythmia type. There is no message or mark to indicate that a certain arrhythmia alarm is turned off, therefore, take care when turning off an arrhythmia alarm.

You can turn on or off the alarm for individual arrhythmia and set threshold for some arrhythmias. The following table shows the setting for each arrhythmia.

Parameter	Detection Condition (Default Setting)	Alarm ON/OFF Setting (Default Setting)
ASYSTOLE	3 to 10 seconds (OR, ICU: 5 s NICU: 3 s)	ON fixed
VF	——	ON fixed
VT	——	ON fixed
VPC RUN	3 to 8 VPCs (3 VPCs)	ON/OFF (OR, NICU: OFF ICU: ON)
COUPLET	——	ON/OFF (OFF)
EARLY VPC	——	ON/OFF (OFF)
BIGEMINY	——	ON/OFF (OFF)
FREQ VPC	1 to 50 VPCs/min (10 VPCs/min)	ON/OFF (OFF)

The arrhythmia alarms can be set individually or can be set altogether using an arrhythmia alarm master.

The arrhythmia alarms can be set on the ARRHYTH ALARM window and on the ARRHYTH ALARM window of the ECG window.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Touch the “ARRHYTH ALARM” tab to display the ARRHYTH ALARM window.

4. Touch the “ON” or “OFF” key to set each arrhythmia type on or off.

5. For the ASYSTOLE, VPC RUN and FREQ VPC, set the detecting condition with the ▲ or ▼ key.

HOME

6. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Number of Electrodes

Change the number of electrodes. If the setting is larger than the actual number, the “CHECK ELECTRODES” message appears and ECG monitoring cannot be performed.

When the number of electrodes is changed, the monitoring lead changes to II.

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Select the number of electrodes from the NUMBER OF ELECTRODES box.

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Sync Source

You can select ECG, SpO_2 pulse (SpO_2) or arterial blood pressure pulse (P1) as the sync source.

When pulse wave and pressure waveform are irregular because of an IABP, select ECG.

When heart rate is unstable because of an electrosurgical unit, select SpO_2 or P1.

NOTE

When the sync source is set to SpO_2 or P1 and the SpO_2 or BP of the multi-parameter 1 socket monitoring is interrupted, the sync source changes to ECG automatically. The sync source returns to SpO_2 or P1 when the SpO_2 or BP is monitored again.

When the sync source is set to ECG and ECG is not measured, there is no sync sound.

When SpO_2 or P1 is selected, the pulse rate is displayed instead of the heart rate on the screen.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “ECG”, “SpO_2” or “P1” key in the SYNC SOURCE box to select the sync source.

5. Press the HOME key on the front panel to return to the monitoring screen.

Selecting the Filter Mode

There are three filter modes for displaying ECG.

MONITOR: The normal mode for monitoring ECG. This mode is good for viewing the overall ECG. The time constant is 0.5 s (0.32 Hz).

DIAG: This mode is best for viewing the details of the waveform. It is similar to the real ECG. The time constant is 3.2 s (0.05 Hz).

MAXIMUM: Use this mode when there is too much noise on the ECG or when you want to suppress baseline drift.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “MAXIMUM”, “MONITOR” or “DIAG” key in the FILTERS box to set the filter.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Selecting the Mode for Updating the Heart Rate

There are two calculation modes, “AVERAGE ECG” and “INSTANT ECG”.

AVERAGE ECG: The heart rate is calculated by a moving average. The monitor detects 8 consecutive beats including VPC, averages the R-R intervals of the latest 8 beats and uses this average to calculate the current heart rate. When a new beat is detected, the heart rate is recalculated using the latest 8 beats. The heart rate display is updated every 3 seconds.

INSTANT ECG: The heart rate is calculated based on the latest 2 beats. The heart rate display is updated every 3 seconds.

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “AVERAGE ECG” or “INSTANT ECG” key in the HR DISPLAY MODE box.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Turning Pacing Spike Detection On/Off

When the patient has an implanted cardiac pacemaker, set this to ON to reject pacemaker spike counting and allow correct heart rate counting.

When you monitor a premature baby or infant and the monitor miscounts the narrow width QRS, set this to Off.

WARNING

- **False low heart rate indicators or false asystole calls may occur with certain pacemakers because of electrical overshoots.**
- **Pacemaker patients can only be monitored when the pace program is active.**
- **Keep pacemaker patients under close observation. The pacemaker rate may be counted during cardiac arrest and certain arrhythmias. Do not rely only on the monitor.**

CAUTION

Turn the pacing spike detection to on when monitoring a pacemaker patient. Otherwise QRS and pacemaker spike may not be distinguished and pacemaker failure may not be recognized.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “ON” or “OFF” key in the DETECTION box of the PACING box to select on or off.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Displaying the Pacing Mark on the ECG

When “DETECTION” is set to ON, the pacing mark can be displayed on the ECG.

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “ECG” key. The ECG window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “ON” or “OFF” key in the MARK box of the PACING box to select on or off.

5. Press the HOME key on the front panel to return to the monitoring screen.

Use with an Electrosurgical Unit

For use with an electrosurgical unit (ESU), this monitor has a circuit to protect the patient from skin burn and to reduce ESU interference on the ECG waveform. However, the effectiveness of this circuit depends on electrode position and monitor setup. With an ESU, pay attention to the following points.

WARNING

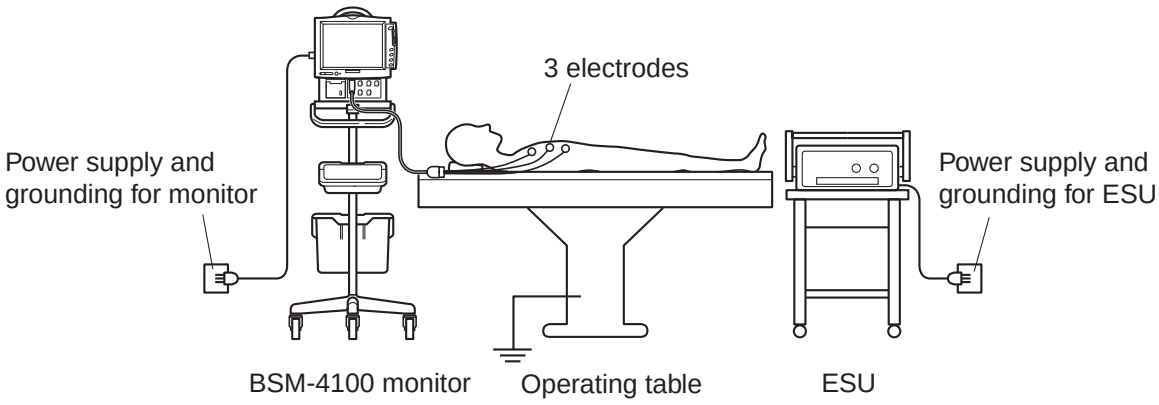
When using this monitor with an ESU, the ESU return plate and the electrodes for monitoring must be firmly attached to the patient. If the return plate is not attached correctly, it may burn the patient's skin where the electrodes are attached. Refer to the instruction manual for the ESU.

CAUTION

Install the monitor and ESU appropriately and perform equipotential grounding. Otherwise, noise from the ESU may interfere with the ECG and ECG monitoring may not be performed properly.

- Arrangement
  Install the monitor as far from the ESU as possible. If possible, locate them on opposite sides of the operating table.

- Power Supply
  Noise from the ESU may interfere with the ECG signal through the AC power line. Supply power to the monitor and ESU from different outlets located as far from each other as possible. Do the equipotential grounding properly.



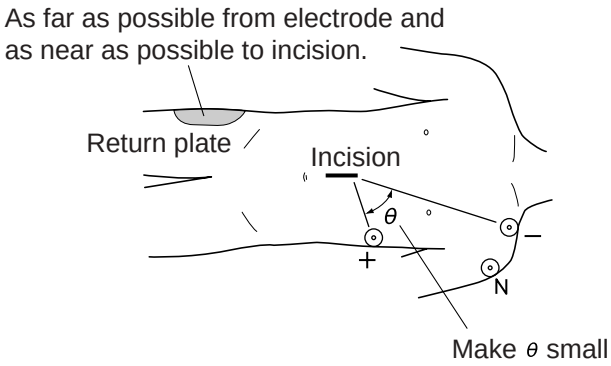
- Measure with 3-electrode Lead
  Use the minimum number of electrodes. Use new electrodes.

- Minimizing Noise
  1. Select an ECG lead where the active ECG electrodes are located as far from the incision as possible.

  2. Position the + and – electrodes as close as possible.

  3. Select the leads where the angle (θ) between the active electrodes and the incision is as small as possible.

  4. Set the electrosurgical return plate as close to the incision as possible.



- Set the following items on the OTHER SETTING window of the ECG window.
  Filters: MONITOR
  Sync Source: SpO_2 or P1
  (When the heart rate is unstable because of an ESU, select SpO_2 or P1.)

- Monitor respiration by thermistor method or monitor CO_2
  Noise is superimposed on the waveform and the respiration rate cannot be monitored accurately in the impedance method. When monitoring respiration, turn respiration monitoring off or monitor the respiration by thermistor method or monitor CO_2.

Section 12 Respiration Monitoring

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General

On this monitor, respiration can be measured by two methods: impedance method and thermistor method. When respiration is measured by both the impedance method and thermistor method, the values measured by the thermistor method are used.

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment*

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. If this occurs, disconnect the monitor or diagnostic equipment from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden distributor.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the patient, resulting in an elevated pacing rate.

  For more information, see the FDA web site.
  http://www.fda.gov/cdrh/safety.html

Measurement Method

Impedance Method

In the impedance method, respiration is measured and monitored by attaching the ECG electrodes to the patient and connecting them to the ECG/RESP socket on the monitor. This method measures changes in impedance between the R and F (RA and LL) or R and L (RA and LA) ECG electrodes.

When the ESU is used in impedance method, noise is superimposed on the waveform and respiration rate cannot be monitored accurately. In such a case, turn the respiration monitoring off or monitor respiration by thermistor method.

Thermistor Method

In the thermistor method, respiration is measured and monitored by attaching the respiration pickup to the patient or connecting it to the respiration circuit, and connecting it to a multi-parameter socket on the monitor.

This method measures and compares temperature changes caused by respiration and inspiration using the respiration pickup.

Use this method when using the ESU or if measurement by the impedance method is unavailable.

Preparing for Respiration Monitoring in Impedance Method

Preparation Flowchart

The procedure is the same as for monitoring ECG.

1. Select the electrode lead.
2. Connect the electrode lead to the ECG connection cord and ECG connection cord to the ECG/RESP socket on the monitor.
3. Attach the disposable electrodes to the patient and attach the electrode lead to the electrodes. Attach R and F (RA and LL) or R and L (RA and LA) with the lungs between the electrodes.
4. Monitoring starts. Set necessary settings.

   For handling accessories after use, refer to Section 21.

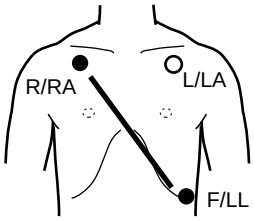
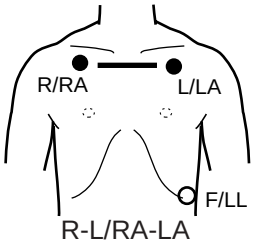
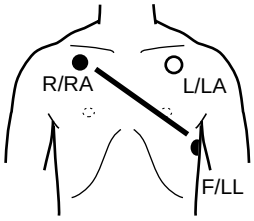
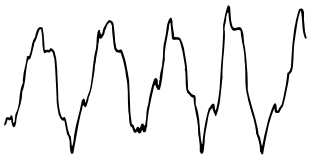
Electrode Position and Waveform Examples

Respiration can be measured by the impedance method when the R (RA) and F (LL) or R (RA) and L (LA) electrodes are placed so that the lungs are between the electrodes.

The optimum electrode positions for ECG monitoring of a patient are not always optimum for respiration monitoring of the patient.

Select the optimum positions for both ECG and respiration measurements or measure respiration by the thermistor method.

The amplitude of the respiration waveform differs according to the electrode positions. The following shows different examples of respiration waveforms according to the electrode position when monitoring with the impedance method.

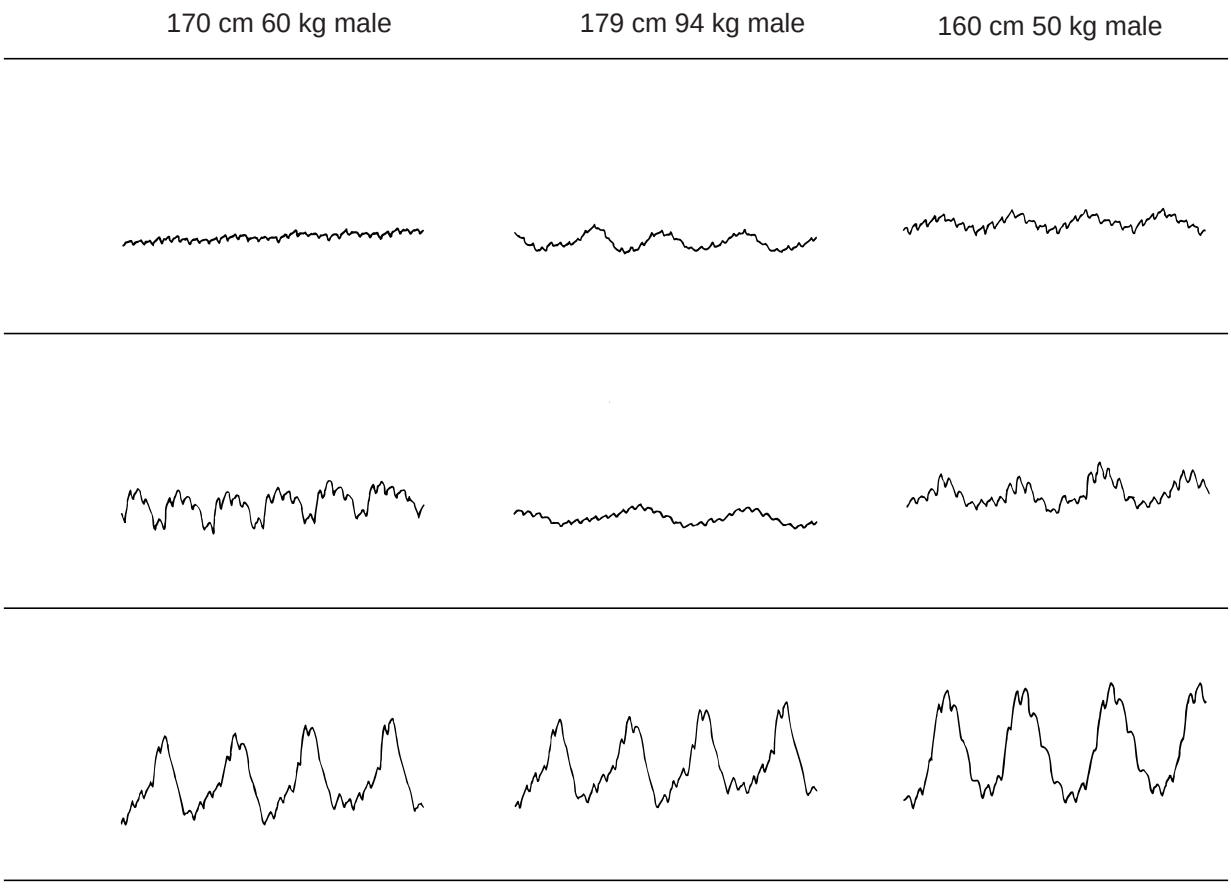
	Electrode lead and position	162 cm 47 kg female	153 cm 45 kg female
1	 Standard R-F/RA-LL		
2	 R-L/RA-LA		
3	 R-F/RA/LL with higher F/LL posiiton		

Electrode Position

	R or RA	F or LL	L or LA
①	Right infraclavicular fossa	Lowest rib on the left anterior axillary line	—
②	Right infraclavicular fossa	—	Left infraclavicular fossa
③	Right infraclavicular fossa	Fifth intercostal space on the left midaxillary line	—

Amplitude

①	Respiration measurement is influenced by movement of the chest and abdomen. The amplitude of the waveform changes greatly according to slight change of the F (LL) electrode position. It also differs considerably between different patients.
②	Respiration measurement is influenced by movement of the chest. Detects thoracic respiration. There is a great difference in amplitude between different patients.
③	Respiration amplitude is large, and therefore, detection rate is good. The electrode position is similar to lead II of the ECG. This position is highly recommended.



Connecting Cables and Attaching Disposable Electrodes

Connecting cables and attaching disposable electrodes are the same as for the ECG monitoring. Refer to “Preparing for ECG Monitoring” in Section 11.

Preparing for Respiration Monitoring in Thermistor Method

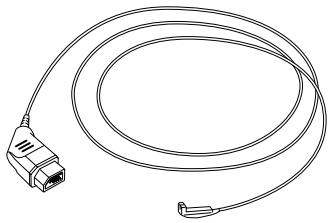
Preparation Flowchart

1. Select the respiration pickup.
2. Connect the respiration pickup to a multi-parameter socket on the monitor.
3. Attach the respiration pickup to the respiration circuit.
4. Monitoring starts. Set necessary settings.

   For handling accessories after use, refer to Section 21.

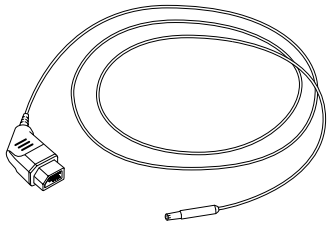
Respiration Pickups

Respiration pickup for nose TR-900P*
For measuring at nostrils.



* This part has not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Respiration pickup for airway TR-910P
For measuring with trachea intubation.

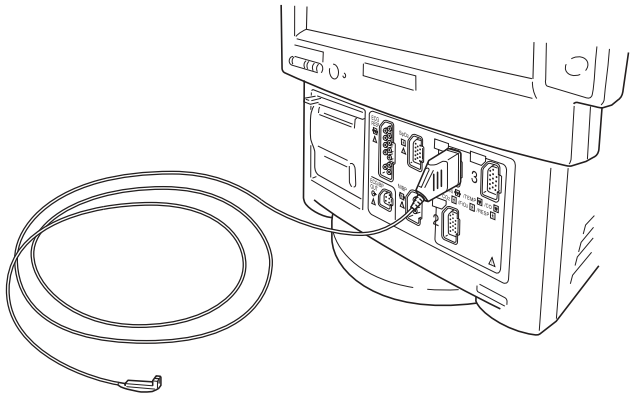


Airway adapter YG-001P
Use with the TR-910P respiration pickup.

Connecting the Cable to the Monitor

Connect the respiration pickup to a multi-parameter socket on the monitor.

When connecting the respiration pickup for nose

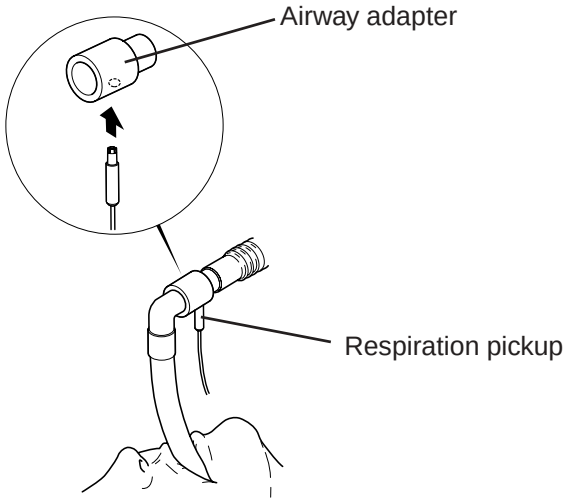


Attaching the Respiration Pickup

When Using Respiration Pickup for Airway

1. Firmly insert the tip of the respiration pickup for airway into the small hole on the airway adapter.

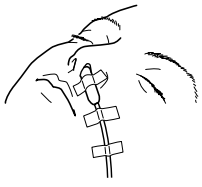
2. Connect the airway adapter to the airway tube (between the mouth and Y-shaped tube).



When Using Respiration Pickup for Nose

1. Place the tip of the respiration pickup at the front of the nostril.

2. Secure the lead wire and respiration pickup firmly to the cheek with surgical tape.



Monitoring Respiration

When preparation is done properly, the respiration waveform appears on the screen.

NOTE

Increase in the temperature of the inspired air during monitoring in thermistor method causes decrease in the temperature difference between inspiration and expiration, and the amplitude of the respiration waveform becomes small. When the inspiration temperature increases higher than the expiration temperature, the phases of expiration and inspiration may be reversed.

In impedance method, the respiration data do not appear on the screen when IMP RESP MEASURE is set to OFF. When using an ESU, noise is superimposed on the waveform and the respiration measurement cannot be monitored accurately. When respiration monitoring is necessary, use the thermistor method or monitor CO_2.

For error messages and monitoring problems, refer to Section 20.

Respiration Information on the Monitoring Screen

Changing Respiration Settings

Change settings on the RESP window. The following settings can be changed for respiration monitoring.

- Turning respiration monitoring on or off in impedance method
- Changing monitoring lead in impedance method
- Respiration sensitivity
- Respiration waveform sweep speed
- Apnea alarm limits
- Respiration rate alarm setting

Turning Respiration Monitoring On or Off in Impedance Method

You can turn respiration monitoring off if you do not need it. When respiration is turned off, the respiration waveform does not appear and the “RESP OFF” message appears on the monitoring screen.

When using ESU, noise is superimposed on the waveform and the respiration measurement cannot be monitored accurately. Set the respiration measurement to OFF or when respiration monitoring is necessary, use thermistor method or monitor CO_2.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “RESP” key. The RESP window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “ON” or “OFF” key in the IMP RESP MEASURE box to set on or off.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Monitoring Lead in Impedance Method

The lead which can be monitored in the impedance method is R-F (RA-LL) or R-L (RA-LA). The selected lead appears on both the monitoring screen and RESP window.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “RESP” key. The RESP window appears.

3. Select the lead.

4. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Respiration Sensitivity

The sensitivity determines the size of the waveform on both the screen and recording paper.

When NOISE REDUCTION ON IMPEDANCE RESP is set to OFF on the SYSTEM SETUP screen, the respiration waveform amplitudes larger than 10 mm are counted for the respiration rate.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “RESP” key. The RESP window appears.

3. Select the sensitivity by touching the desired sensitivity in the SENSITIVITY box.

HOME

4. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Respiration Waveform Sweep Speed

The respiration waveform sweep speed on the screen can be selected from 1, 6, or 25 or 50 mm/s. This setting can also be changed on the DISPLAY window.

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “RESP” key. The RESP window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Select the respiration waveform sweep speed from the RESP/CO2 SWEEP SPEED box.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Apnea Alarm Limit

CAUTION

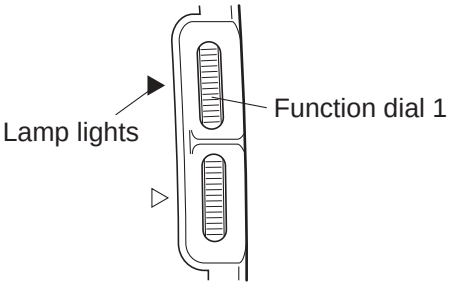
When the alarm limit is turned off, there will be no apnea alarm.

You can set the apnea alarm limit on the RESP window. You can set all alarms, including the apnea alarm limit, on the VITAL ALARM window (See Section 6).

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “RESP” key. The RESP window appears.



3. Do one of the following:

   Use the function dial 1 to change the setting.

   Or,

   Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

4. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Respiration Alarm Limits

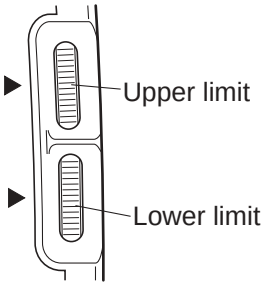
CAUTION

When the upper or lower alarm limit is turned off, there will be no respiration rate upper or lower alarm for that limit.

You can set the upper and lower respiration rate alarm limits on this window. Other alarm items must be set on the VITAL ALARM window. You can set all alarms, including the upper and lower respiration rate alarm limits, on the VITAL ALARM window (See Section 6).

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “RESP” key. The RESP window appears.



3. Do one of the following:

   Use the function dials to change settings.

   Or,

   1) Touch the upper limit box to set the upper limit or touch the lower limit box to set the lower limit.

   2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   Or,

   Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum or the lower limit is set to a value below the minimum, the alarm is set to OFF.

4. Press the HOME key on the front panel to return to the monitoring screen.

Section 13 SpO_2 Monitoring

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General

SpO_2 is monitored by attaching a probe to the patient and using the SpO_2 socket on the monitor.

WARNING

- **Measurement may be incorrect in the following cases.**
  - **When the patient's carboxyhemoglobin or methemoglobin increases abnormally.**
  - **When dye is injected in the blood.**
  - **When using an electrical surgery unit.**
  - **During CPR.**
  - **When there is body movement.**
  - **When there is vibration.**
  - **When measuring at a site with venous pulse.**
  - **When the pulse wave is small (insufficient peripheral circulation).**
  - **When using an IABP (intra-aortic balloon pump).**
- **Check the circulation condition by observing the skin color of the measuring site and pulse waveform. Change the measuring site every 8 hours for disposable probes and every 4 hours for reusable probes. The skin temperature may increase at the attached site by 2 or 3°C (4 or 5°F) and cause a burn or pressure necrosis. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.**
  - **A patient with a fever**
  - **A patient with peripheral circulation insufficiency**
  - **Neonate or low birth weight infant with delicate skin**
- **To avoid poor circulation, do not wrap the tape too tight. Check the blood circulation condition by observing the skin color and congestion at the skin peripheral to the probe attachment site. Even for short-term monitoring, there may be burn or pressure necrosis from poor blood circulation, especially on neonates or low birth weight infants whose skin is delicate. Accurate measurement cannot be performed on a site with poor peripheral circulation.**
- **When not monitoring SpO_2, disconnect the SpO_2 connection cord from the monitor. Otherwise, noise may interfere from the probe sensor and incorrect data is displayed on the screen.**

CAUTION

- **Turn off the power of cell telephones, small wireless devices and other devices which produce strong electromagnetic interference. Otherwise, the waveforms and measurements are affected by such interference and the displayed data may be incorrect.**

- **Normally external light does not affect monitoring, however, strong light such as an operating lamp or sunlight may affect monitoring. If affected, cover the measuring site with a blanket.**
- **Do not pull or bend the probe cable, and do not put caster feet on the probe cable. Do not immerse the probe cable in detergents or water. Failure to follow these cautions may cause cable discontinuity, short circuit, skin burn on the patient and incorrect measurement data. Replace any broken probe with a new one.**
- **While a patient is on medication which causes vasodilation, the pulse waveform may change and in rare cases the SpO_2 value may not be displayed.**

NOTICE

Purchase of this instrument confers no express or implied license under any Nellcor Puritan Bennett patent to use this instrument with any oximetry sensor that is not manufactured or licensed by Nellcor Puritan Bennett.

The above notice only applies to the BSM-4102/4104/4112/4114 monitors.

Preparing for SpO_2 Monitoring

Preparation Flowchart

1. Select the probe.
2. Connect the probe to the SpO_2 connection cord and SpO_2 connection cord to the SpO_2 socket on the monitor.
3. Attach the probe to the patient.
4. Monitoring starts. Set necessary settings.

   For handling accessories after use, refer to Section 21.

Selecting a Probe

Select the appropriate probe according to the purpose. Use Nihon Kohden probes on the BSM-4101/4103/4111/4113 monitors and Nellcor probes on the BSM-4102/4104/4112/4114 monitors.

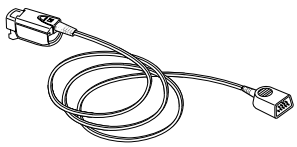
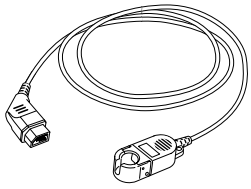
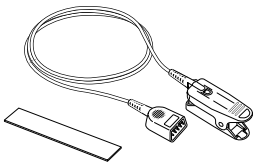
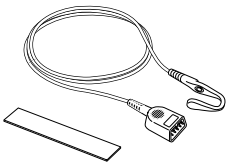
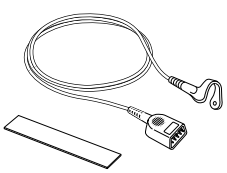
WARNING

- **Do not use the probe during MRI examination because it may cause skinburn on the probe attachment area. For details, follow the MRI operator's manual.**
- **Do not use a deteriorated probe because measured data may be incorrect.**

CAUTION

- **Only use the specified probes. Otherwise SpO_2 cannot be monitored properly.**
- **Do not use a damaged or disassembled probe. It causes incorrect measurement and may hurt the patient.**

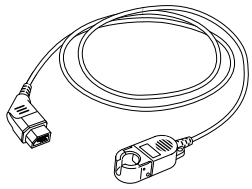
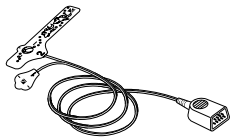
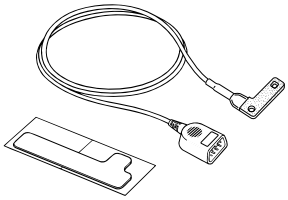
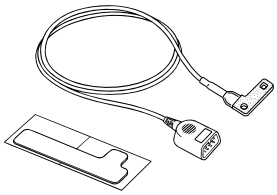
Nihon Kohden Reusable Probes

Model	Subject (Weight)	Attachment Site	SpO2 Connection Cord
Finger Probe TL-201T 	Adults, children (Weight more than 20 kg)	Finger	JL-900P 
Finger Probe TL-101T 	Adults, children (Weight more than 20 kg)	Finger or toe	
Multi-site Probe TL-120T 	Adults, children, infants (Weight more than 3 kg)	Finger or toe	
Foot Probe TL-121T 	Infants, neonates (Weight less than 3 kg)	Instep and sole	

Nihon Kohden Disposable Probes

CAUTION

- **Do not reuse the disposable probes for another patient because it causes cross infection.**
- **Disposable probes are not sterilized. To sterilize the probe, refer to "Sterilizing the Disposable Probe" in Section 21.**

Model	Subject (Weight)	Attachment Site	SpO2 Connection Cord
TL-251T	Adults (Weight more than 30 kg)	Finger or toe	JL-900P 
TL-252T	Children (Weight from 3 to 40 kg)	Finger or toe	
TL-253T 	Neonates (Weight less than 3 kg)	Instep and sole	
TL-051S/052S  Cable length TL-051S: 80 cm TL-052S: 160 cm	Adults (Weight more than 50 kg)	Finger	
	Neonates (Weight less than 3 kg)	Instep and sole	
TL-061S/062S  Cable length TL-061S: 80 cm TL-062S: 160 cm	Adults, children (Weight from 15 to 50 kg)	Finger	
	Children, infants (Weight from 3 to 15 kg)	Toe	

Nellcor SpO_2 Probes for the BSM-4102/4104/4112/4114 Monitors

To use Nellcor probes, the specified connection cord is required.
When there is a "Nellcor OxiMax™" label at the SpO_2 socket on the socket panel, use the OEM-10 connection cord. Otherwise, use the MC-10 or SCP-10 connection cord.

CAUTION

Only use the correct connection cord. SpO_2 cannot be monitored if a different cord is used.

Nellcor probes and cables are available direct from Nellcor Puritan Bennett or their suppliers.

CAUTION

Do not reuse adhesive probes for other patient.

The following Nellcor probes can be used with this bedside monitor regardless of whether or not there is a "Nellcor OxiMax™" label at the SpO_2 socket on the socket panel.

Measuring Range: R-15 probe: 80 to 100%SpO_2
Other probes: 70 to 100%SpO_2

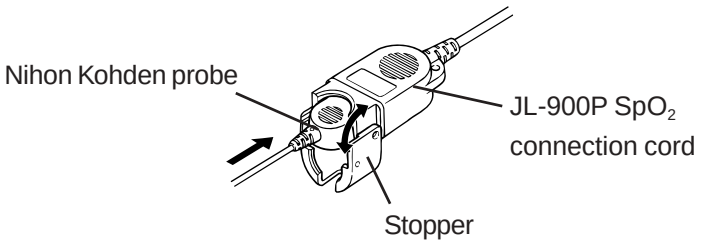
DS-100A (accuracy ±3% SpO_2)
OXIBAND A/N (accuracy ±3% SpO_2)
OXIBAND P/I (accuracy ±3% SpO_2)
RS-10 (accuracy ±3.5% SpO_2)
D-YS (accuracy ±3% SpO_2)
D-YSE (accuracy ±3.5% SpO_2)
D-YSPD (accuracy ±3.5% SpO_2)
D-25/D-25L (accuracy ±2% SpO_2)
N-25 (accuracy ±2% SpO_2)
I-20 (accuracy ±2% SpO_2)
D-20 (accuracy ±2% SpO_2)
R-15 (accuracy ±3.5% SpO_2)
OXICLIQ I (accuracy ±2.5% SpO_2)
OXICLIQ P (accuracy ±2.5% SpO_2)
OXICLIQ A (accuracy ±2.5% SpO_2)
OXICLIQ N (accuracy ±2.5% SpO_2)
OXI1-2-3 A/N (accuracy ±2.5% SpO_2)
OXI1-2-3 P/I (accuracy ±2.5% SpO_2)

Connecting Cables

Connecting Cable to the Monitor

1. Open the stopper of the SpO_2 connection cord and connect the probe firmly.

2. Close the stopper.

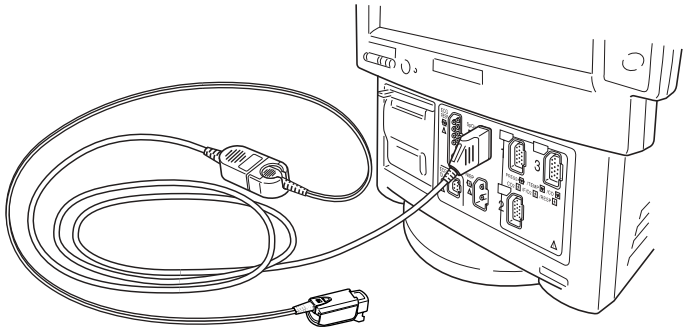


3. Connect the SpO_2 connection cord to the SpO_2 socket on the monitor.

CAUTION

When using Nellcor probes on the BSM-4102/4104/4112/4114 monitors, do not touch the SpO_2 socket pins on the monitor with your finger when connecting or disconnecting the connection cord from the monitor. The monitor may malfunction or get damaged.

<When using TL-201T Finger Probe>



Attaching the Probe to the Patient

WARNING

- **Check the circulation condition by observing the skin color of the measuring site and pulse waveform. Change the measuring site every 8 hours for disposable probes and every 4 hours for reusable probes. The skin temperature may increase at the attached site by 2 or 3°C (4 or 5°F) and cause a burn or pressure necrosis. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.**
  - **A patient with a fever**
  - **A patient with peripheral circulation insufficiency**
  - **Neonate or low birth weight infant with delicate skin**
- **To avoid poor circulation, do not wrap the tape too tight. Check the blood circulation condition by observing the skin color and**

congestion at the skin peripheral to the probe attachment site. Even for short-term monitoring, there may be burn or pressure necrosis from poor blood circulation, especially on neonates or low birth weight infants whose skin is delicate. Accurate measurement cannot be performed on a site with poor peripheral circulation.

CAUTION

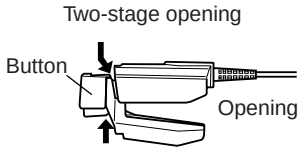
- **When using Nellcor probes, read the instructions provided with the probe.**
- **If the attachment site is dirty with blood, clean the attachment site before attaching the probe. If there is nail polish on the attachment site, remove the polish. Otherwise, the amount of transmitted light decreases, and measured value may be incorrect or measurement cannot be performed.**
- **If the skin gets irritated or redness appears on the skin from the probe, change the attachment site or stop using the probe.**
- **Do not attach the probe to the same limb that is used for NIBP measurement or an IBP catheter.**
- **When attached, make sure that the light emitter and the photo detector of the probe face each other. Otherwise, SpO_2 cannot be measured properly.**
- **Do not reuse the disposable probes for another patient because it causes cross infection.**
- **Do not use the probe over its stated lifetime. Otherwise the SpO_2 measurement accuracy cannot be guaranteed.**
- **When the probe is attached on an appropriate site with sufficient circulation and the error message confirming the probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.**
- **Do not pull or bend the probe cable, and do not put caster feet on the probe cable. Do not immerse the probe cable in detergents or water. Failure to follow these cautions may cause cable discontinuity, short circuit, skin burn on the patient and incorrect measurement data. Replace any broken probe with a new one.**
- **Do not immerse the probe in detergents or water. If the probe adhesive surface gets wet, adhesiveness becomes weak and the probe cannot be attached to the skin.**
- **Refer to the probe instruction manual for details.**

NOTE

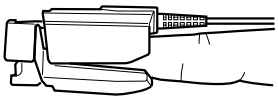
If the patient has long fingernails, cut the nail. The probe cannot be attached properly if the nail is long.

The light-transmission type probe requires the light to penetrate tissue of 6 to 14 mm thick (e.g. finger or toe). The best monitoring condition is tissue approximately 10 mm thick.

Attaching the TL-201T Finger Probe



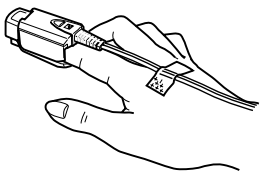
1. Clean the attachment site with alcohol.
2. Press the button to open the probe.



3. Insert the finger into the probe. The ⍓ marked side must be on the nail side (the cable must be on the nail side) and there should be slight contact between the tip of the finger and the probe.

NOTE

Make sure that the cable is on the nail side. Otherwise measured data is not correct.



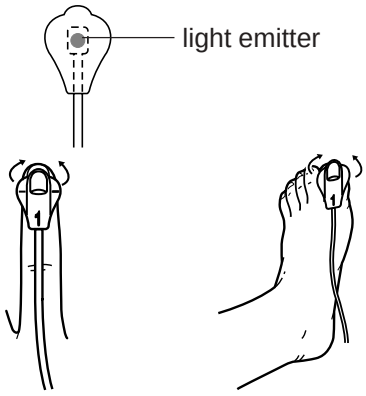
4. To minimize body movement and prevent extra force on the probe for stable SpO_2 monitoring, secure the cable to the back of the hand with surgical tape.

Attaching the TL-251T/252T/253T Disposable Probes

NOTE

When attached, make sure that the light emitter and the detector of the probe face each other. Otherwise, SpO_2 cannot be measured properly.

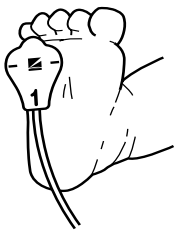
1. Wipe the attachment site with a cotton moistened with alcohol.



TL-251T/252T

2. Remove the cover paper from the back of the probe piece 1 and attach the probe piece to the cleaned site.

- When attaching TL-251T/252T
  Attach the entire probe piece to the finger or toe so that the center of the light emitter is on the base of the nail.

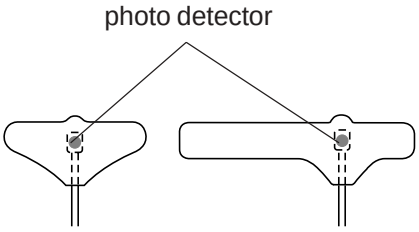


TL-253T

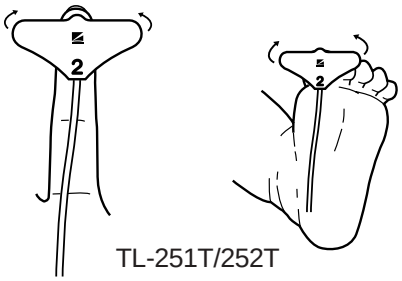
- When attaching TL-253T
  Attach the entire probe piece to the bottom of the foot so that the center of the light emitter aligns with the little toe and the edge of the light emitter is where the toe joins the foot.

NOTE

Do not attach the light emitter on a joint.

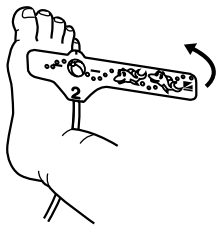


3. Remove the cover paper from the back of the probe piece 2 and attach the probe piece.



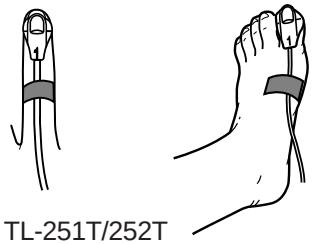
TL-251T/252T

- When attaching TL-251T/252T
  1) Attach the probe piece to the opposite side of the finger or toe from the nail, so that the center of the photo detector on the probe piece 2 exactly faces the light emitter on the probe piece 1.
  2) Wrap the left and right wing of the probe piece 2 one at a time to the finger or toe to attach the whole probe piece. Be careful not to wrinkle the wing.

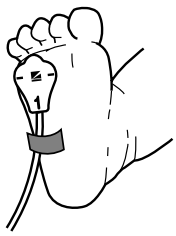


TL-253T

- When attaching TL-253T
  1) Attach the probe piece to the instep of the foot so that the center of the photo detector on the probe piece 2 exactly faces the light emitter on the probe piece 1.
  2) Wrap the probe piece to the foot to attach the whole probe piece.



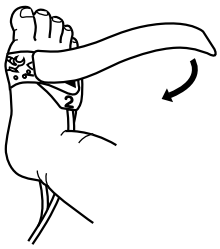
TL-251T/252T



TL-253T

4. For stable SpO_2 monitoring, secure the cable with surgical tape to minimize and prevent extra force on the probe.

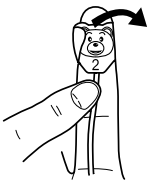
   When the probe is repositioned and its adhesiveness becomes weak, use the provided tape to secure the probe.



Removing the TL-251T/252T/253T Disposable Probe from the Attachment Site

CAUTION

- **Be careful when removing the probe from neonatal skin.**
- **When removing a probe that is taped to the skin, do not pull the cable part of the probe because this can damage the probe's cable connection.**



Hold the cable where it joins the probe piece and remove the probe piece slowly from the edge of it.

Monitoring SpO_2

When the preparation is done properly, the SpO_2 value and pulse waveform appear on the screen.

WARNING

- **Measurement may be incorrect in the following cases.**
  - **When the patient's carboxyhemoglobin or methemoglobin increases abnormally.**
  - **When dye is injected in the blood.**
  - **When using an electrical surgery unit.**
  - **During CPR.**
  - **When there is body movement.**
  - **When there is vibration.**
  - **When measuring at a site with venous pulse.**
  - **When the pulse wave is small (insufficient peripheral circulation).**
  - **When using an IABP (intra-aortic balloon pump).**
- **Check the circulation condition by observing the skin color of the measuring site and pulse waveform. Change the measuring site every 8 hours for disposable probes and every 4 hours for reusable probes. The skin temperature may increase at the attached site by 2 or 3°C (4 or 5°F) and cause a burn or pressure necrosis. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.**
  - **A patient with a fever**
  - **A patient with peripheral circulation insufficiency**
  - **Neonate or low birth weight infant with delicate skin**
- **To avoid poor circulation, do not wrap the tape too tight. Check the blood circulation condition by observing the skin color and congestion at the skin peripheral to the probe attachment site. Even for short-term monitoring, there may be burn or pressure necrosis from poor blood circulation, especially on neonates or low birth weight infants whose skin is delicate. Accurate measurement cannot be performed on a site with poor peripheral circulation.**
- **When not monitoring SpO_2, disconnect the SpO_2 connection cord from the monitor. Otherwise, noise may interfere from the probe sensor and incorrect data is displayed on the screen.**

CAUTION

- **When the probe is attached on an appropriate site with sufficient circulation and the error message confirming the probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.**

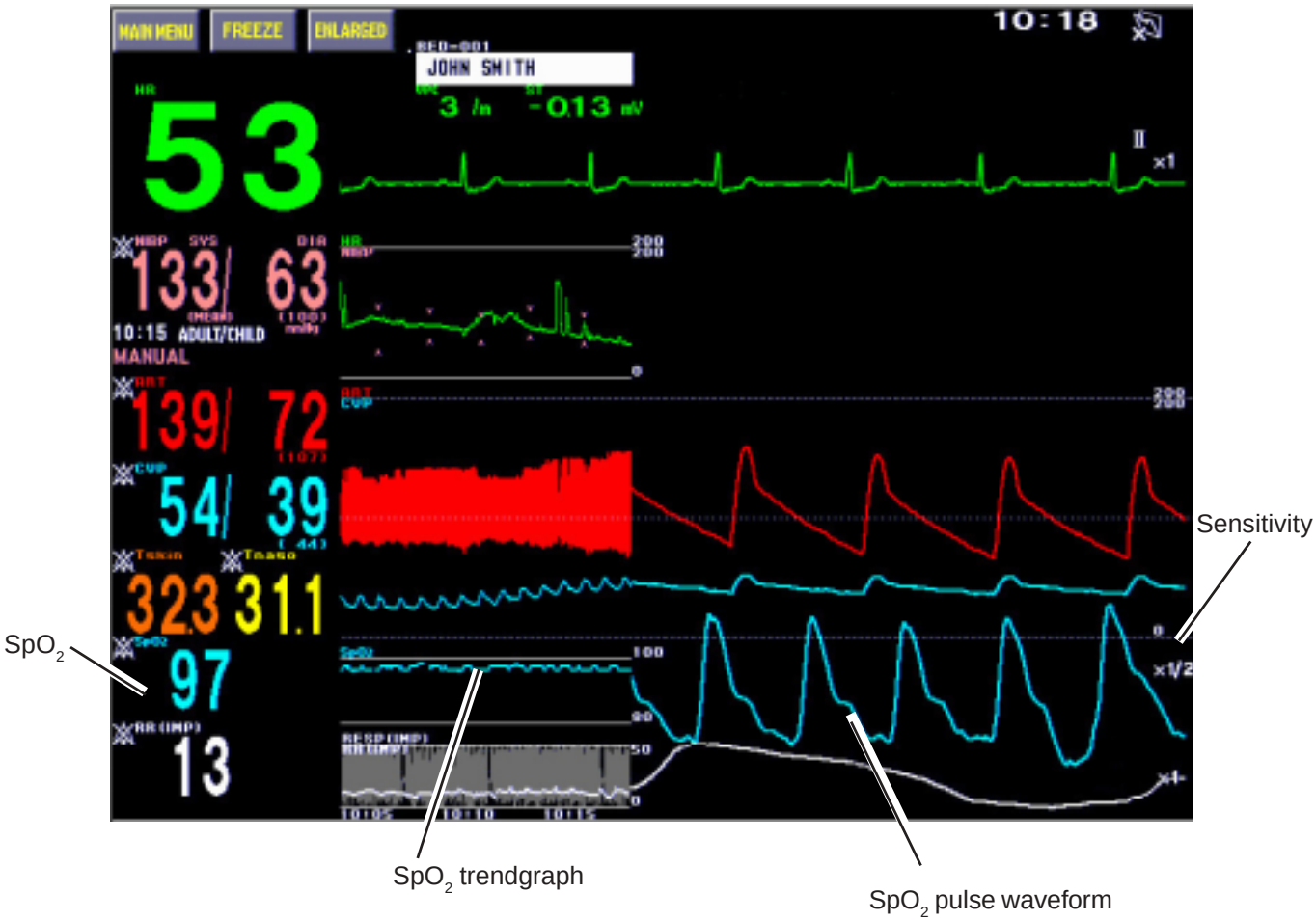
- **When the probe or SpO_2 connection cord failure message appears on the screen, replace it with a new one. Otherwise SpO_2 data may not be accurate.**

NOTE

In order to maintain sufficient blood circulation, keep the measurement site warm by covering with a blanket or something similar. Warming the site is effective, especially for a patient with a small pulse amplitude.

For error messages and monitoring problems, refer to Section 20.

SpO_2 Information on the Monitoring Screen



Detection and Display of Measurement Condition

CHECK PROBE Message (When the Finger Probe is Used)

This message is displayed highlighted with one “bong” sounding every 20 seconds and yellow alarm lamp lit when the SpO_2 connection cord is disconnected from the probe or SpO_2 socket on the monitor, the probe is not firmly attached to the patient, or the amount of transmitted light is too small for measurement.

Check the SpO_2 connection cord connection and firmly attach the probe to the patient or reposition the probe so that more light can pass through.

PULSE SEARCH Message

Displayed when the detected pulse waveform is too small.

After attaching the probe to the patient, it takes 10 to 20 seconds to automatically adjust the gain. When the pulse waveform is detected satisfactorily, the “PULSE SEARCH” message disappears and the SpO_2 value appears.

NOTE

When the “PULSE SEARCH” message is displayed for a long time, it means that the detected pulse is too small to measure. Reposition the probe.

M Message

Displayed when there is considerable body movement or the probe attachment is unstable. When the message is displayed frequently, check the patient condition, and if necessary, change the probe attachment site.

“M” stands for “Movement” or “Motion artifact”.

Changing SpO_2 Settings

Change settings on the SpO_2 window. The following settings can be changed for SpO_2 monitoring.

- Select the pulse wave sensitivity
- SpO_2 alarm threshold
- Changing the sync source
- Setting the pitch of the sync sound
- Changing the response mode

Changing the Pulse Waveform Sensitivity

The sensitivity determines the size of the waveform on both the screen and recording paper.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “SpO2” key. The SpO_2 window appears.

3. Select the sensitivity by touching the desired sensitivity in the SENSITIVITY box.

   When "AUTO" is set, the sensitivity is automatically set so that the SpO_2 waveform with the optimum amplitude is displayed on the monitoring screen.

HOME

4. Press the HOME key on the front panel to return to the monitoring screen.

Changing the SpO_2 Alarm Limits

CAUTION

When the upper or lower alarm limit is turned off, there will be no SpO_2 upper or lower alarm for that limit.

You can set the upper and lower SpO_2 alarm limits on this window. Other alarm items must be set on the VITAL ALARM window. You can set all alarms, including the upper and lower SpO_2 alarm limits, on the VITAL ALARM window (See Section 6).

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "SpO2" key. The SpO_2 window appears.

3. Do one of the following:

   Use the function dials to change settings.

   Or,

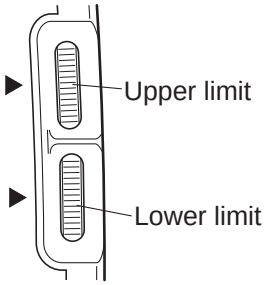
   1) Touch the upper limit box to set the upper limit or touch the lower limit box to set the lower limit.

   2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   Or,

   Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum or the lower limit is set to a value below the minimum, the alarm is set to OFF.



4. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Sync Source

You can select ECG, SpO_2 pulse (SpO_2) or arterial blood pressure pulse (P1) as the sync source.

When pulse wave and pressure waveform are irregular because of an IABP, select ECG.

When heart rate is unstable because of an electrosurgical unit, select SpO_2 or P1.

NOTE

When the sync source is set to SpO_2 or P1 and the SpO_2 or BP of the multi-parameter 1 socket monitoring is interrupted, the sync source changes to ECG automatically. The sync source returns to SpO_2 or P1 when the SpO_2 or BP is monitored again.

When the sync source is set to ECG and ECG is not measured, there is no sync sound.

When SpO_2 or P1 is selected, the pulse rate is displayed instead of the heart rate on the screen.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “SpO2” key. The SpO_2 window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “ECG”, “SpO_2” or “P1” key in the SYNC SOURCE box to select the sync source.

5. Press the HOME key on the front panel to return to the monitoring screen.

Selecting Sync Sound Pitch

The sync sound can be variable pitch or fixed pitch pips. The fixed pitch is high pitch as the default, but medium or low pitch can also be set. See Section 3. When you select variable pitch, the pitch of the sync sound changes according to SpO_2 value or systolic BP value of the arterial blood pressure.

When the variable pitch with SpO_2 value is selected, the pitch of the sync sound changes as follows.

SpO2 Value	Pitch of Sync Sound
100 to 81%	High to low pitch, in 1% steps
Less than 81%	Low pitch

When the variable pitch with systolic BP value is selected, the pitch of the sync sound changes as follows.

Systolic BP Value	Pitch of Sync Sound
Higher than 120 mmHg	High pitch
120 to 20 mmHg	High to low pitch, in 5 mmHg steps
Less than 20 mmHg	Low pitch

When the sync source is set to SpO_2 and the “CHECK PROBE” or “PULSE SEARCH” message appears on the screen, the sync sound stops.

When the sync source is set to ECG or P1, sync pitch is set to SpO_2 and the “CHECK PROBE” or “PULSE SEARCH” message appears on the screen, the low pitch is selected automatically.

When the SpO_2 connection cord or IBP connection cord is disconnected from the monitor, ECG is automatically selected as the sync source.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “SpO2” key. The SpO_2 window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “FIXED”, “SpO_2” or “P1” key in the SYNC PITCH box to select the sync pitch.

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Response Mode

The response mode setting is only available for:

- BSM-4101/4103/4111/4113 monitors
- BSM-4102/4104/4112/4114 monitors with a "Nellcor OxiMax™" label on the socket panel

Each response mode uses a different time to enable accurate measurement according to the patient condition. When the measurement condition is unstable, response becomes slower in all modes.

For BSM-4101/4103/4111/4113 monitors, there are three response modes.

FAST: Select this mode for special applications that require a fast response. "FAST" is suitable for detecting short apnea.
NORMAL: For normal monitoring.
SLOW: Select this mode when you need to suppress a rapid change in SpO_2.

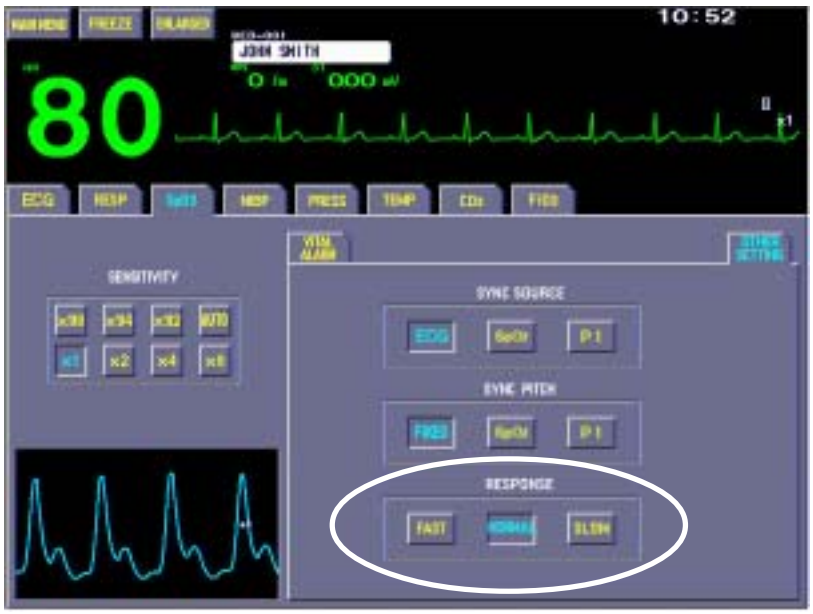
For BSM-4102/4104/4112/4114 monitors with a "Nellcor OxiMax™" label on the socket panel, there are two response modes.

FAST: Select this mode for special applications that require a fast response. "FAST" is suitable for detecting short apnea.
NORMAL: For normal monitoring.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "SpO2" key. The SpO_2 window appears.

3. Touch the "OTHER SETTING" tab to display the OTHER SETTING window.



BSM-4101/4103/4111/4113 monitors

BSM-4102/4104/4112/4114 monitors with a
"Nellcor OxiMax™" label on the socket panel

4. Touch the key for the desired mode in the RESPONSE box to select the response mode.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Section 14 NIBP Monitoring

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Connecting Cables and Attaching the Cuff to the Patient 14.7
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The NIBP measuring method in this monitor is licensed from Critikon Inc., U.S.A.

General

Non-invasive blood pressure is measured by wrapping the cuff on the patient and connecting the cuff to the NIBP socket on the monitor. In this monitor, non-invasive blood pressure is measured by the oscillometric method.

Oscillometric method

The NIBP is measured from the change in amplitude pattern of pulsatile oscillation in cuff pressure as the cuff pressure is reduced from above systolic to below diastolic pressure. The occlusive-oscillometry method uses this to determine the systolic, diastolic, and mean arterial pressure.

The systolic pressure is the pressure at which the pulsatile oscillation suddenly increases, and the diastolic pressure is the pressure at which the pulsatile oscillation suddenly decreases. The mean arterial pressure is the point where maximum pulsatile oscillation occurs.

There are three modes for NIBP measurement on this monitor. Refer to the "Selecting the Measurement Mode and Interval" section.

- Single measurement — Measurement is performed once.
- STAT (continuous) measurement — Measurement is performed for 15 minutes continuously.
- Automatic measurement — Measurement is performed automatically at preset time intervals. The time interval can be selected. Automatic measurement can also be performed with PWTT (available only for the BSM-4101/4103/4111/4113 monitors).

WARNING

- **NIBP measurement on a sickle cell anemia patient may cause a thrombus.**
- **When attaching the cuff to a premature infant at an early stage after birth, periodically change the cuff position to avoid possible skin erosion and fissure.**

CAUTION

Do not wrap the cuff on the arm or thigh which is used for injection. NIBP measurement on an arm or thigh which is used for injection may cause a reflux of blood and stop injection.

Preparing for NIBP Measurement

Preparation Flowchart

1. Select the cuff.
2. Connect the cuff to the air hose and air hose to the NIBP socket on the monitor.
3. Attach the cuff to the patient.
4. Set necessary settings.
5. Start measurements.

   For handling accessories after use, refer to Section 21.

Selecting the Cuff

CAUTION

- **Only use the specified cuff. Otherwise NIBP monitoring cannot be performed properly or the monitor may be damaged.**
- **Select the cuff which fits each patient. If the cuff size is not correct, measurement may not be completed or the result may be incorrect.**

Select the appropriate cuff according to the purpose.

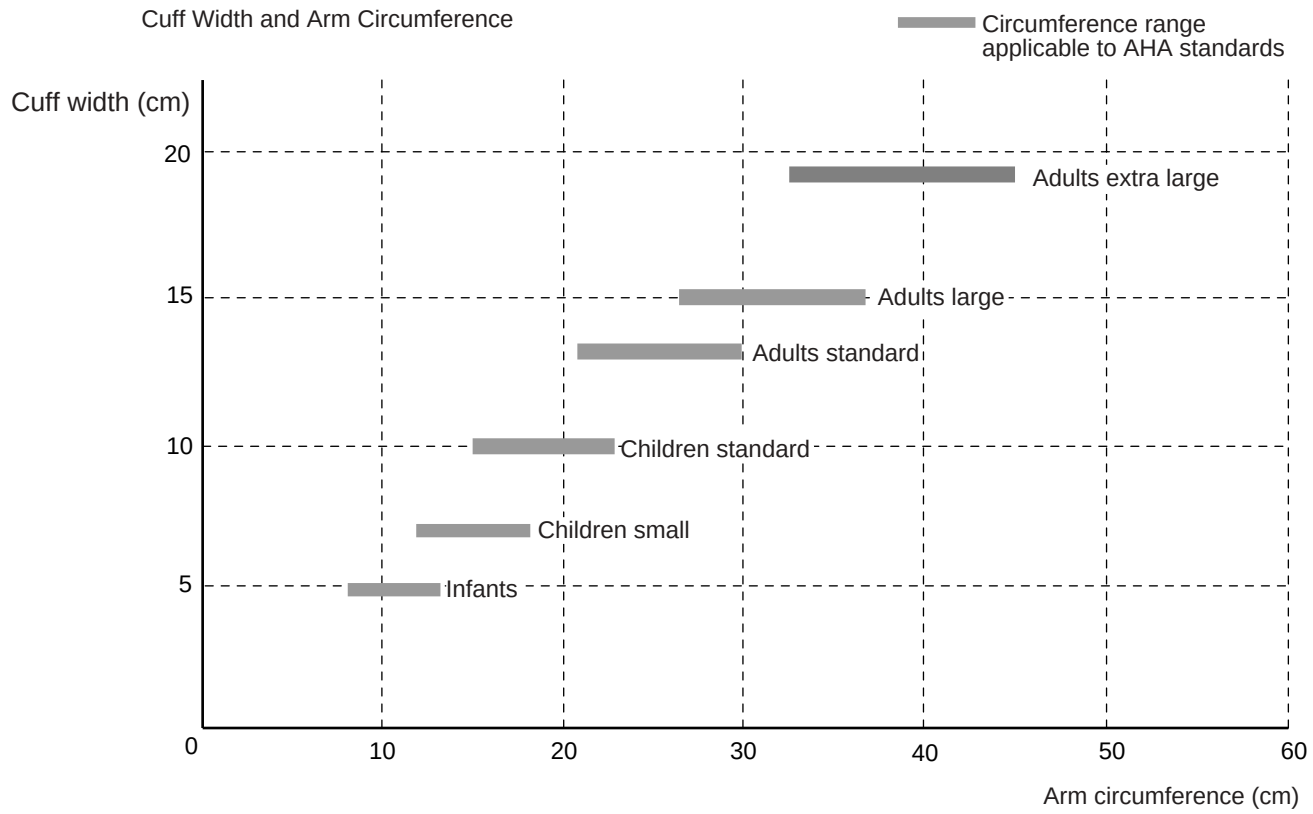
The AHA (American Heart Association) recommends that the cuff width be 40% of the circumference of the upper arm. Refer to the following graph and select the cuff which suits the patient's arm.

NOTE

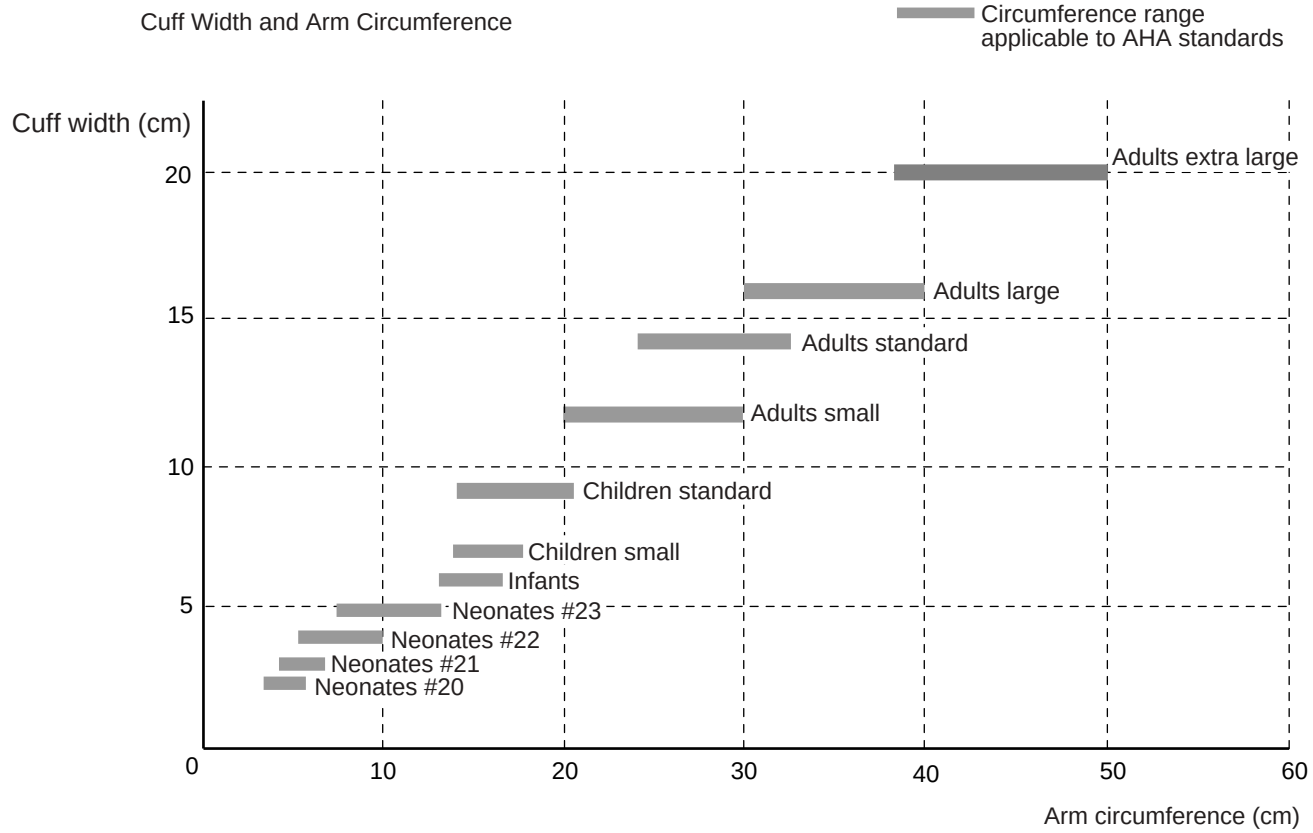
- **If the range of arm circumference appropriate for the cuff is prescribed, use within that range.**
- **To obtain accurate measured values, select a wide cuff which can be attached to the upper arm or the thigh (calf in the case of neonates). Measuring with a very narrow cuff may result in measured values higher than the actual values.**

Cuff Width and Arm Circumference

YP-950T/951T/952T/953T/954T/955T/960T/961T/962T/963T/964T/965T cuffs



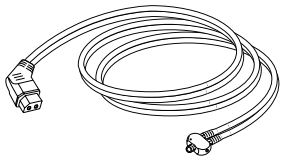
YP-900P/901P/902P/903P/904P/905P/906P/920P/921P/922P/923P cuffs



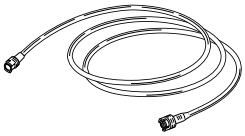
Types of Cuffs

Reusable Cuffs

When using the following reusable cuffs, a YN-900P (1.5 m) or YN-901P (3.5 m) air hose is required. A YN-990P (1.5 m) extension hose is also available.

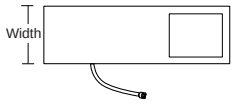
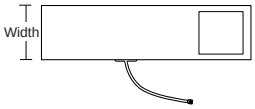


Air hose

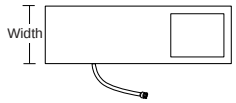
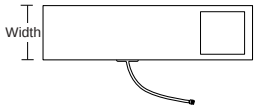


Extension hose

For the YP-960T/961T/962T/963T/964T/965T reusable cuffs, the cloth cover can be separated from the rubber hose so that the cloth cover can be washed. The rubber hose is latex-free.

Cuff			Width (cm)	Applicable circumference (cm)	Shape
For infants		YP-960T	5	8 to 13	
For children	Small	YP-961T	7	12 to 18	
	Standard	YP-962T	10	15 to 23	
For adults	Standard	YP-963T	13	21 to 30	
	Large	YP-964T	15	26 to 36	
For thigh		YP-965T	19	33 to 45	

For the YP-950T/951T/952T/953T/954T/955T reusable cuffs, the cloth cover can be separated from the rubber hose so that the cloth cover can be washed. The rubber hose contains natural rubber latex.

Cuff			Width (cm)	Applicable circumference (cm)	Shape
For infants		YP-950T*	5	8 to 13	
For children	Small	YP-951T*	7	12 to 18	
	Standard	YP-952T*	10	15 to 23	
For adults	Standard	YP-953T*	13	21 to 30	
	Large	YP-954T*	15	26 to 36	
For thigh		YP-955T*	19	33 to 45	

CAUTION

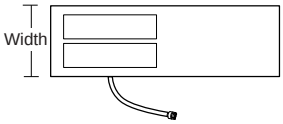
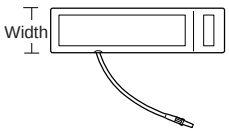
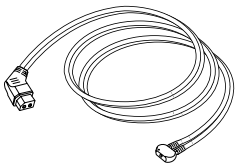
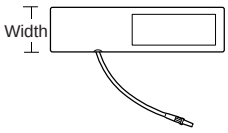
*** These Products Contain Natural Rubber Latex Which May Cause Allergic Reactions.**

Natural rubber may cause allergic reaction with symptoms such as itching, redness, urticaria, swelling, fever, dyspnea, symptoms similar to asthma, reduced blood pressure and shock. If the patient shows any of the above symptoms, immediately stop using the cuff and perform appropriate medical treatment.

Disposable Cuffs

CAUTION

- **Do not sterilize the non-sterilized disposable cuffs for neonates.**
- **Do not reuse disposable cuffs.**

Cuff			Width (cm)	Applicable circumference (cm)	Shape	Air Hose
Infants (Non-sterilized)		YP-910P	6	13 to 16		YN-900P (1.5 m) YN-901P (3.5 m) Extension hose YN-990P (1.5 m)
Children (Non-sterilized)		YP-912P	9	19 to 22.5		
Adults (Non-sterilized)	Small	YP-913P	12	20 to 30		
	Standard	YP-914P	14	23 to 35		
	Large	YP-915P	16	30 to 40		
	Extra large	YP-916P	20	38 to 50		
Neonates (Non-sterilized)	#20	YP-920P	2.5	3 to 6		YN-920P (1.5 m) YN-921P (3.5 m) 
	#21	YP-921P	3	4 to 7.5		
	#22	YP-922P	4	5.5 to 10		
	#23	YP-923P	5	7 to 13		
Neonates (Sterilized)		No. 11*	3	5 to 7.5		
		No. 12*	4	7.5 to 10.5		
		No. 13*	5	8.5 to 13		

* This part has not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

If necessary, sterilize the disposable cuffs for infants, children and adults using glutaraldehyde solution by following its instructions.

The non-sterilized disposable cuffs for neonates cannot be sterilized. If necessary, use sterilized disposable cuffs for neonates.

Disinfecting Disposable Cuffs before Use

If necessary, disinfect the cuffs before use. The disposable cuffs for neonates cannot be disinfected.

NOTE

Do not let water get inside the cuff. If water gets inside the cuff, use a new one.

1. Wipe the cuff with a cloth moistened with neutral soap water or isopropyl alcohol.

   When soap water is used, rinse the cuff thoroughly with water.

2. Immerse the cuff in a disinfectant solution. Refer to the disinfectant instructions.

3. Rinse the cuff thoroughly with a sterilized solution.

4. Dry the cuff at room temperature. Do not heat the cuff.

Connecting Cables and Attaching the Cuff to the Patient

Connecting Air Hose and Cuff to the Monitor

CAUTION

Confirm that the air hoses are firmly connected between the sockets and hoses of the cuff. If not connected properly (the air hose connector clicks when properly inserted into the socket), the cuff cannot be correctly identified and air leakage will cause incorrect NIBP data or no data.

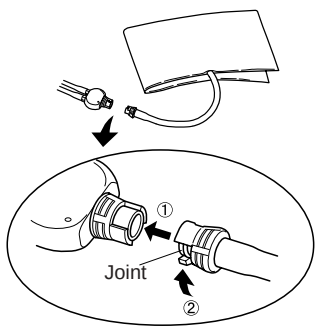
NOTE

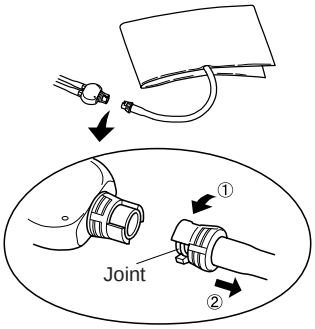
Before using the cuff, check and confirm that there is no flaw, crack or hole on the cuff. If the rubber cuff is cracked, has a hole or is not elastic, it may burst.

1. Connect the cuff to the air hose.

   Connecting the Cuff for Adults and Children

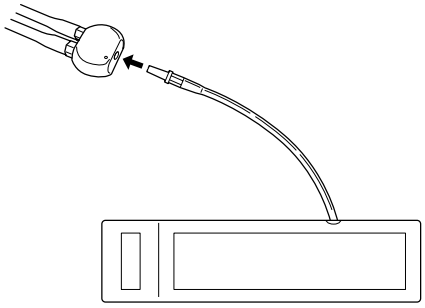
   Insert the cuff connector joint into the air hose and turn it clockwise until it clicks.





To disconnect the cuff from the air hose, turn the cuff connector joint counterclockwise to unlock it and remove it from the air hose.

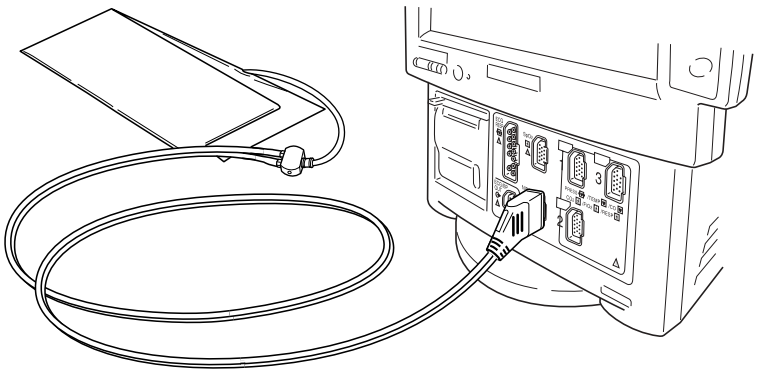
Connecting the Cuff for Neonates



2. Connect the air hose to the NIBP socket on the monitor.

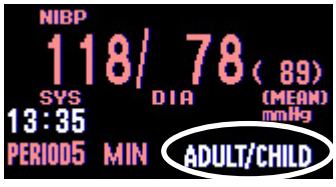
   The monitor automatically identifies the type of the connected cuff (subject of measurement), and displays it on the NIBP window.

   When Connecting the YP-904P Cuff for Adults



3. Check that the correct type of cuff is displayed on the monitoring screen.

   When using cuff for adults or children, “ADULT/CHILD” appears on the screen. When using cuff for neonates, “NEONATE” appears on the screen.



Attaching the Cuff to the Patient

How to Wrap the Cuff

WARNING

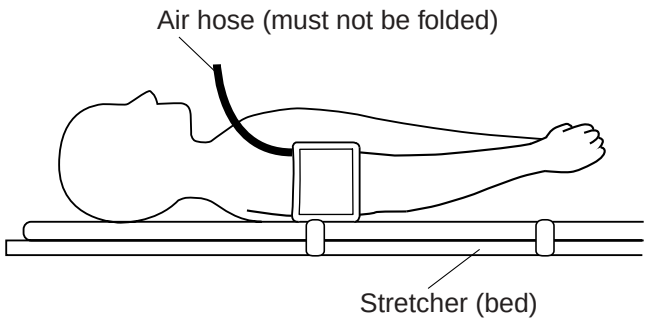
- **When attaching the cuff to a premature infant at an early stage after birth, periodically change the cuff position to avoid possible skin erosion and fissure.**
- **NIBP measurement on a sickle cell anemia patient may cause a thrombus.**

CAUTION

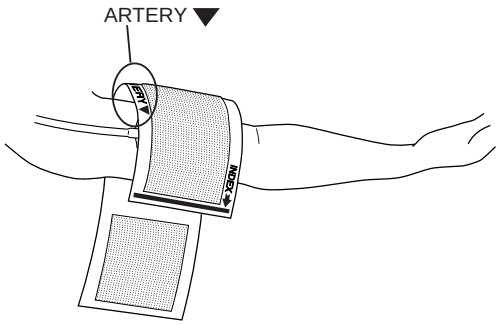
Do not wrap the cuff to the arm or thigh which is used for injection. NIBP measurement on an arm or thigh which is used for injection may cause a reflux of blood and stop injection.

When wrapping the cuff around the upper arm, observe the following points.

- The cuff must not wrap around the elbow.
- The cuff should just wrap around the upper arm, not too tightly or too loosely. A tightly wrapped cuff can cause discomfort to the patient and decreases pressure reading, and a loosely wrapped cuff prolongs the measurement time and increases the blood pressure reading. If the cuff pressure does not increase, the monitor will automatically stop inflating in 180 seconds (90 seconds when measuring a neonate) and stop the measuring procedure for patient safety.
- To prevent external vibration from affecting the measurement, the cuff and the cuff hoses should not touch the stretcher or the stretcher's railing. Use an elbow rest (any soft object) to support the cuffed arm naturally and to keep the cuff from touching the stretcher.
- The air hose must not be folded or kinked.
- In principle, the cuff should be wrapped around a bare upper arm. Thick clothing can damp the pulsatile oscillation of the cuff pressure. It is still possible to obtain a measurement if the cuff is wrapped around thin clothing over the upper arm.



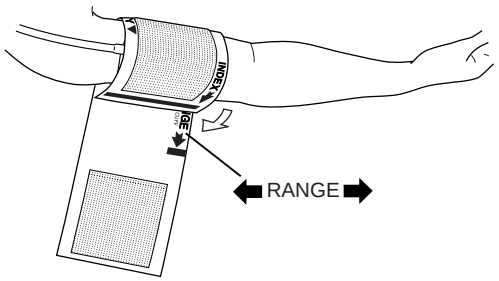
When Using the YP-950T/951T/952T/953T/954T/955T/ 960T/961T/962T/963T/964T/965T Reusable Cuffs



1. Put the cuff on the upper arm so that the ▼ mark of the "ARTERY ▼ " aligns with the artery of the patient.

NOTE

The cuff must not wrap around the elbow.



2. Wrap the cuff so that the "INDEX ➡" comes within the "⬅ RANGE ➡".

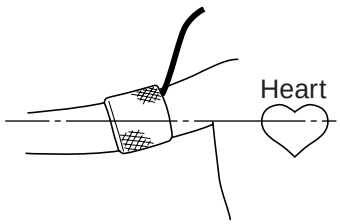
   If the "INDEX ➡" is not within the "⬅ RANGE ➡", change the cuff size.

Cuff Hose and Air Hose

Confirm that the hoses are not folded, kinked or squeezed.

CAUTION

When too much pressure is applied to the cuff, or the hose is folded, the "NIBP SAFETY CIRCUIT RUNNING" message appears on the screen and NIBP monitoring may be stopped. Remove the cause, wait for 40 seconds, check that the message disappears, then measure again.



Cuff Position (Height of Cuff from Heart Level)

Place the cuffed upper arm (brachium) at the same height as the patient's heart. If the cuff is not at the same level as the heart, the weight of the blood affects the blood pressure reading. The pressure difference per unit height is 0.7 mmHg/cm. The blood pressure reading decreases when the arm is higher than the heart and increases when lower.

The best measuring condition is when the patient is lying on his/her back with arms and legs relaxed. If the cuff position cannot be on the same level as the heart, the displayed blood pressure reading must be mathematically adjusted.

Changing NIBP Settings

NOTE

To change settings for monitoring neonate NIBP, the cuff for neonates must be connected to the cuff socket.

Change settings on the NIBP window. The following settings can be changed for monitoring NIBP.

- Initial cuff inflation pressure
- Measurement mode and interval
- NIBP alarm limits
- Measurement interval which can be called up by the NIBP INTERVAL key
- Automatic measurement with PWTT on and trigger threshold (PWTT is available only on the BSM-4101/4103/4111/4113 monitors).

The following items can be set on the SYSTEM SETUP screen. Refer to Section 3.

- Measurement completion sound on or off.
- Measurement mode after STAT measurement.
- STAT measurement mode (STAT or 1 minute interval).
- Time after NIBP measurement for the NIBP data to become dark
- Measurement mode after the monitor power is off for more than 30 minutes or the monitor is initialized

The NIBP unit (mmHg or kPa) is the same as the pressure unit. The pressure unit is set on the SYSTEM SETUP screen. Refer to Section 3.

Selecting the Initial Cuff Inflation Pressure

The initial cuff inflation pressure changes to the factory default setting when the air hose is disconnected from the NIBP socket on the monitor.

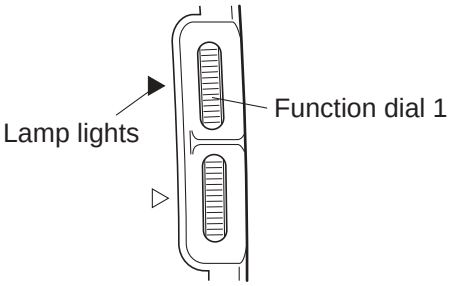
1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “NIBP” key. The NIBP window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Change the setting. The default setting is 180 mmHg for adult and 100 mmHg for neonate. After the first measurement, the cuff inflation pressure is the systolic value of the previous measurement plus 20 mmHg.

Patient Type	Setting Range (10 mmHg/step)	Default Setting
Adult	100 to 280	180
Neonate	70 to 120	100



Use the function dial 1 on the front panel to change settings.

Or,

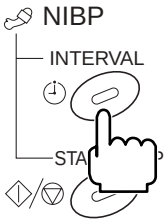
Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

5. Press the HOME key on the front panel to return to the monitoring screen.

Selecting the Measurement Mode and Interval

Measurement Modes

There are three measurement modes. The selected mode or interval is displayed below or to the right of NIBP measurement data on a monitoring screen.



The measurement mode and interval can be changed by pressing the NIBP INTERVAL key on the front panel. It can also be changed on the NIBP window on the screen.

When the NIBP INTERVAL key on the front panel is pressed, the measurement mode changes according to the modes selected on the HARD KEY INTERVALS window. MANUAL mode is already selected for the mode selection. To select the modes for the NIBP INTERVAL key, refer to the “Selecting the Measurement Modes for the Mode Selection by the NIBP INTERVAL Key” section.

When the monitor is initialized or the monitor power is turned off for more than 30 minutes, the measurement mode changes to the mode selected for the INTERVAL MASTER on the SYSTEM SETUP screen . Refer to Section 3.

Manual Measurement

In Manual mode, a single NIBP measurement is performed when the ◇/▽ NIBP START/STOP key on the front panel is pressed.

STAT (Continuous) Measurement

WARNING

While performing STAT measurements many times without a pause, periodically check the blood vessels and limb for adequate circulation.

In STAT mode, measurement is continuously repeated for 15 minutes after the ◇/▽ NIBP START/STOP key is pressed. There are two modes.

- Measure NIBP as many times as possible over a 15 minute period.
- Measure NIBP every minute for a 15 minute period.

Select the mode on NIBP STAT MODE on the SYSTEM SETUP screen. Refer to Section 3.

When the STAT measurement for 15 minutes is completed, the measurement mode automatically changes to the Manual mode or Auto mode at 2, 2.5, 5, 10, 15, 30 or 60 minute interval depending on the NIBP MODE AFTER STAT setting on the SYSTEM SETUP screen. The default setting is Manual mode. Refer to Section 3.

When the "BYPASS" or "SUSPEND MONITORING" key is pressed, STAT measurement is suspended until the ◇/▽ NIBP START/STOP key is pressed.

Auto Measurement

WARNING

When performing long term measurements at intervals less than 2.5 minutes, periodically check the state of the patient, blood vessels and limb for adequate circulation.

In Auto mode, measurement is performed automatically at the preset time intervals. The time interval can be selected from the intervals preset on the HARD KEY INTERVALS window by pressing the ◷ NIBP INTERVAL key on the front panel. It can also be changed at MEASUREMENT INTERVAL on the NIBP window.

The actual measurement time is automatically timed from the next nearest selected interval. For example, if you start measurement at 9:02 with 5 min interval, the measurement will be performed at 9:05, 9:10, 9:15 and so on. If you start measurement at 10:35 with 60 min interval, the measurement will be performed at 11:00, 12:00, 13:00 and so on.

In the Auto mode, a single measurement can be performed by pressing the ◇/▽ NIBP START/STOP key on the front panel between auto measurements.

When the "BYPASS" or "SUSPEND MONITORING" key is pressed, Auto measurement is suspended until the ◇/▽ NIBP START/STOP key is pressed.

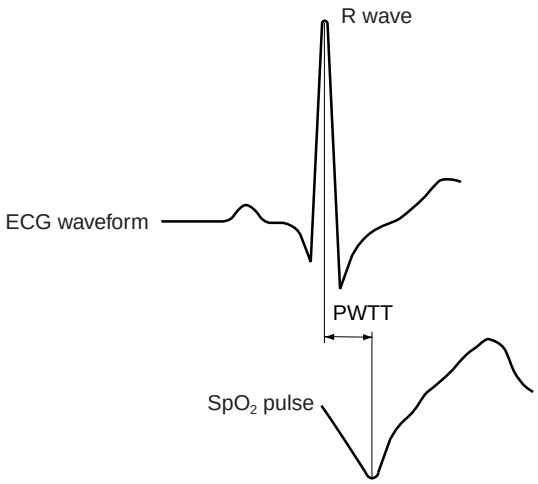
NOTE

The NIBP measurement time of the NIBP list on the LIST window is the time the measurement is completed.

Automatic Measurement with PWTT

PWTT is available only for the BSM-4101/4103/4111/4113 monitors.

PWTT (pulse wave transit time) is a parameter which can indicate sudden change in blood pressure. PWTT is the interval between the R wave of the ECG and the onset of the SpO_2 pulse wave. In many cases, PWTT changes according to change in circulation. This PWTT change (delta PWTT) can be used to trigger NIBP measurement. When the delta PWTT exceeds a preset threshold, it triggers NIBP measurement. Therefore, PWTT can be used to monitor sudden critical changes in blood pressure which may go undetected by the usual periodic NIBP measurement.



CAUTION

- **Do not rely only on the PWTT to monitor blood pressure changes. When it is necessary to monitor critical blood pressure change, set the appropriate interval for NIBP measurement.**
- **When the delta PWTT threshold is too short for a patient, NIBP measurement may be performed too frequently. If this occurs, change the delta PWTT threshold to a longer time.**
- **The PWTT may be incorrect when there is too much arrhythmia or noise.**
- **In the following cases, PWTT may trigger too many or no NIBP measurements. Check the patient condition. If necessary, change the delta PWTT threshold or set the PWTT to Off.**
  - **Rapid blood pressure change with vasoreflex due to vasoactive drugs, such as phenylephrine and nicardipine.**
  - **Unstable pulse wave due to poor peripheral circulation.**
  - **Too many arrhythmias.**
  - **Patient movement.**
  - **Noise on ECG due to ESU.**
  - **SpO_2 measurement on foot of a child.**
- **Do not measure NIBP with PWTT on a neonate because circulation of a neonate changes rapidly.**

To use PWTT in automatic NIBP measurement, you must set the delta PWTT threshold on the PWTT window of the NIBP window and the NIBP measurement mode to one of the intervals. To change settings for PWTT, refer to the "Changing the PWTT Settings" section. NIBP is measured at the selected interval and when the delta PWTT exceeds the preset threshold.

NOTE

- **NIBP measurement with PWTT can only be performed when the NIBP measurement mode is set to one of the intervals.**
- **NIBP measurement with PWTT is performed when ECG and SpO_2 are monitored. When ECG or SpO_2 is not monitored, delta PWTT appears blank on the monitoring screen.**
- **When using PWTT for NIBP measurement during operation, set arrhythmia analysis on the ECG window to on. If set to off, the PWTT may be incorrect due to ESU. Refer to Section 11.**

When the automatic measurement with PWTT is set to On, delta PWTT is displayed in the upper right corner on the monitoring screen.

During and after the automatic measurement with PWTT, "PWTT" is highlighted.

Selecting the Measurement Modes for the Mode Selection by the NIBP INTERVAL Key

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "NIBP" key. The NIBP window appears.

3. Touch the “HARD KEY INTERVALS” tab to display the HARD KEY INTERVALS window.

4. Select the measurement mode and intervals for the mode selection by the NIBP INTERVAL key on the front panel.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the NIBP Alarm Settings

CAUTION

When the upper or lower alarm limit is turned off, there will be no NIBP upper or lower alarm for that limit.

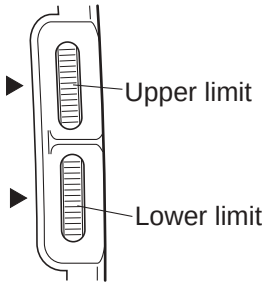
You can set the upper and lower systolic, diastolic and mean NIBP alarm limits on the NIBP window. Other alarm items must be set on the VITAL ALARM window. You can set all alarms, including the upper and lower NIBP alarm limits, on the VITAL ALARM window (See Section 6).

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “NIBP” key. The NIBP window appears.

3. Touch the alarm setting bar.



4. Use the function dials to change settings.

   Or,

   1) Touch the upper limit box to set the upper limit or touch the lower limit box to set the lower limit.

   2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   Or,

   Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum, or the lower limit is set to a value below the minimum, the alarm is set to OFF.

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the PWTT Settings

PWTT is available only for the BSM-4101/4103/4111/4113 monitors.

You can select automatic NIBP measurement with or without PWTT. When PWTT is set to on, you can also select the delta PWTT threshold for triggering NIBP measurement.

To trigger NIBP measurement with a smaller change in blood pressure, set the delta PWTT threshold to a shorter time.

If NIBP measurement is performed too frequently, set the delta PWTT threshold to a longer time.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “NIBP” key. The NIBP window appears.

3. Touch the “PWTT” tab to display the PWTT window.

4. Select “ON” or “OFF” for PWTT.
   When set to “ON”, automatic NIBP measurement with PWTT is performed.

   When set to “ON”, select the delta PWTT threshold (in ms). Touch the desired level on the setting bar in the TRIGGER TIME box. Touch the ▲ or ▼ key to adjust the setting.

5. Press the HOME key on the front panel to return to the monitoring screen.

Measuring and Monitoring NIBP

When the preparation is done properly, you can start non-invasive blood pressure measurements and monitoring.

The monitor automatically identifies the type of cuff connected and sets the cuff inflation pressure.

WARNING

When performing long term measurements at intervals less than 2.5 minutes, periodically check the state of the patient, blood vessels and limb for adequate circulation.

CAUTION

- **When the "CONNECTOR OFF" message appears on the screen, connect the air hose to the socket properly. NIBP cannot be monitored and the alarm does not function properly while this message is displayed.**
- **When too much pressure is applied to the cuff, or the hose is folded or kinked, the "NIBP SAFETY CIRCUIT RUNNING" message appears on the screen and NIBP monitoring may be stopped. Remove the cause, wait for 40 seconds, check that the message disappears, then measure again.**

NOTE

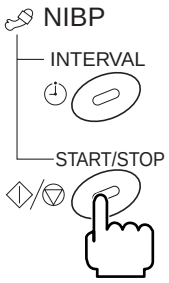
- **When measuring patients who are conscious, help the patient to relax. Measurement may not be accurate if the patient's arm is tense or if the patient talks.**
- **The data for measurement on the thigh tends to be higher than measurement on the arm.**
- **Do not apply pressure to the cuff or air hose. NIBP may not be measured correctly because of the noise or NIBP measurement may stop due to the NIBP safety circuit running.**

For error messages and monitoring problems, refer to Section 20.

Recommended Patient State

Keep the patient quiet and maintain the patient's arm in a relaxed position during NIBP measurement so that measurement can be done under optimal conditions.

Starting and Stopping NIBP Measurement



Starting and stopping can be controlled by the ◇/▽ NIBP START/STOP key on the front panel. Before starting measurement, select the measurement mode. Refer to the "Selecting the Measurement Mode and Interval" section.

NOTE

After NIBP measurement, the next measurement cannot start until the cuff pressure is less than 10 mmHg (2 mmHg in the NEONATE mode) for more than 3 seconds.

Manual Mode

To start the NIBP measurement in the Manual mode, press the ◇/▽ NIBP START/STOP key. The single measurement starts and automatically stops. To cancel it, press this key again during measurement.

STAT Mode

To start the NIBP measurement in the STAT mode, press the ◇/▽ NIBP START/STOP key. The measurement will be continuously repeated for 15 minutes. To stop (cancel) it within the 15 minutes, press this key again.

After completing the STAT measurement, the measurement mode changes to the mode set on "NIBP MODE AFTER STAT" on the SYSTEM SETUP screen. Refer to Section 3.

Auto Mode

The Auto mode works when one of the time intervals is selected.

The first NIBP measurement is performed when the ◇/▽ NIBP START/STOP key is pressed. The second measurement is performed when the current time (minutes) in the monitor reaches the nearest time interval selected. Refer to the "Selecting the Measurement Mode and Interval" section.

During auto measurement, the measurement mode is highlighted on the monitoring screen.

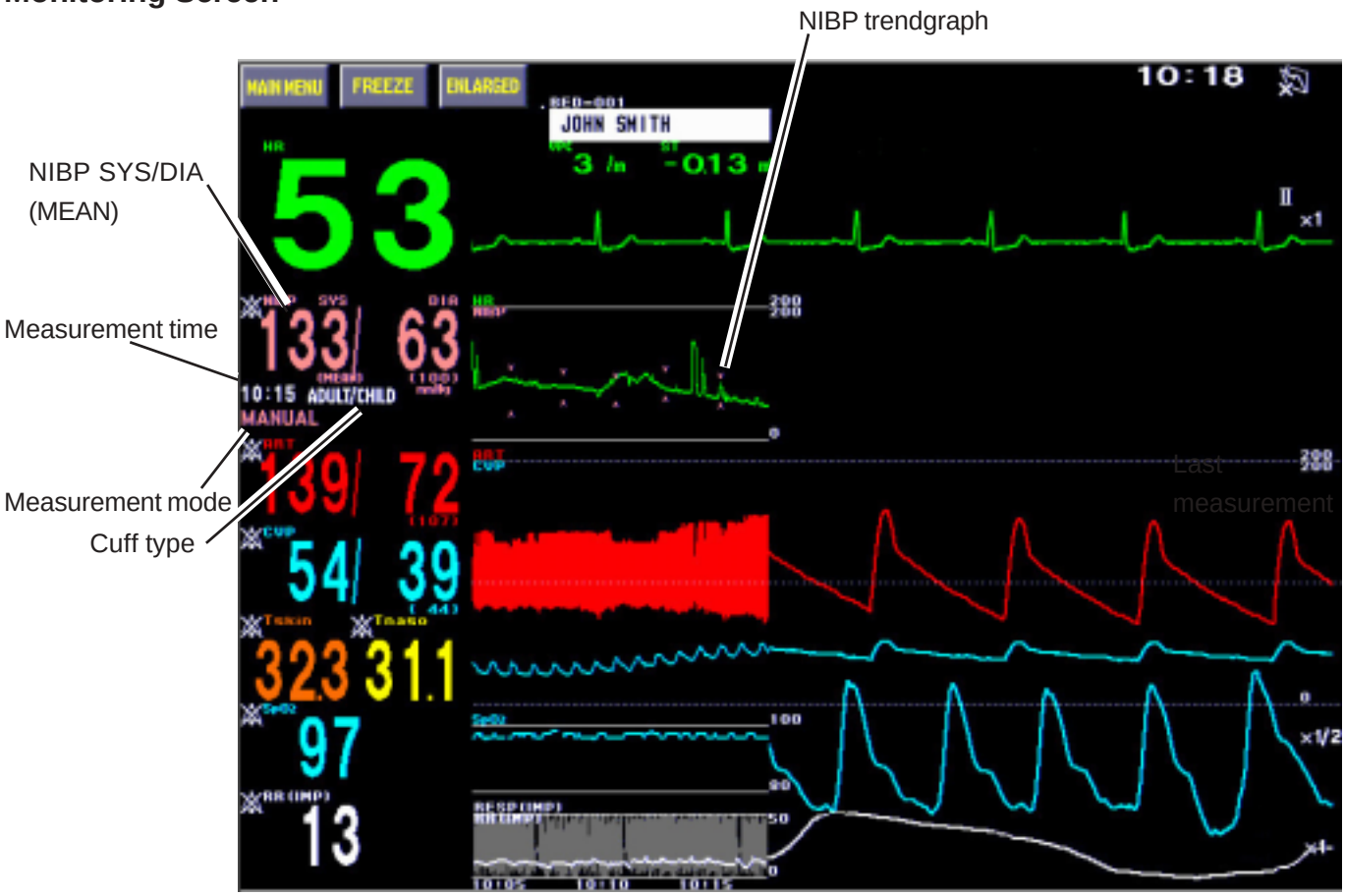
When PWTT is set to ON and trigger threshold is set on the PWTT window of the NIBP window, NIBP is automatically measured when the PWTT exceeds the threshold. Refer to the "Changing the PWTT Settings" section for changing PWTT settings.

To stop NIBP measurement in auto mode, change the mode to Manual.

To cancel one measurement, press the ◇/▽ NIBP START/STOP key during the measurement.

To perform a single measurement in this mode, press the ◇/▽ NIBP START/STOP key once between auto measurements.

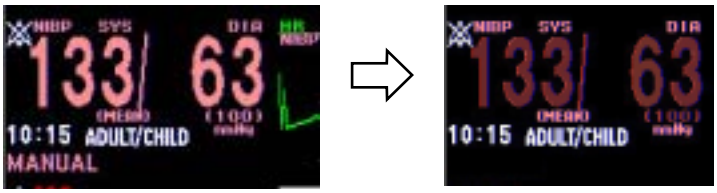
NIBP Information on the Monitoring Screen



Dimming and Hiding the NIBP Data

When the time set at OLD NIBP AFTER on the SYSTEM SETUP screen elapses after the last measurement, the NIBP data on the monitoring screen is dimmed or hidden. Whether to dim or hide the old data can be selected at OLD NIBP DATA on the SYSTEM SETUP screen. Refer to Section 3.

(Example: Dim old NIBP data)



Section 15 IBP Monitoring

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  - IBP Connection Cords 15.4
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General

Invasive blood pressure and intracranial pressure (ICP) are measured and monitored by connecting the blood pressure measuring device to the multi-parameter socket on the monitor. Up to 2 channels on the BSM-4101/4102/4111/4112 monitors and up to 3 channels on the BSM-4103/4104/4113/4114 monitors can be measured (1 socket, 1 channel).

When using the blood pressure pulse as a sync sound or the output signal of invasive blood pressure as a sync signal of the IABP (intra-aortic balloon pump) device, use the multi-parameter 1 socket on the monitor. Other multi-parameter sockets cannot output blood pressure signals.

CAUTION

Turn off the power of cellular telephones, small wireless devices and other devices which produce strong electromagnetic interference. Otherwise, the waveforms and measurements are affected by such interference and the displayed data may be incorrect.

Using the Output Signal from the ECG/BP OUT Socket

WARNING

When using the output signal from the module as the synchronization signal for other equipment such as IABP (intra-aortic balloon pump) or defibrillator:

- **Set the timing of the other equipment by checking the waveform on the monitoring screen.**
- **Check the condition of the bedside monitor at all times. The output signal may become unstable.**
- **The hum filter is always set to on for the ECG output. ECG output differs from the ECG on the monitor screen regardless to the filter setting.**
- **Check that the delay time of the output signal (heart rate trigger 64 ms maximum) is within the range of the connected equipment.**
- **Do not use the heart rate trigger as the synchronization signal for a defibrillator.**

NOTE

The output signal from the ECG/BP OUT socket may become unstable in the following conditions.

- **Electrode is dry or detached.**
- **Electrode lead is damaged or disconnected from the electrode.**
- **Electrode lead is pulled.**
- **AC interference or EMG noise superimposed.**
- **Air bubbles or blood clog in the circuit for monitoring IBP.**
- **Cord or cable is disconnected or damaged.**

Preparing for Blood Pressure Monitoring

Preparation Flowchart

1. Select the blood pressure measuring device.

2. Install the blood pressure measuring device and connect the blood pressure transducer to the IBP connection cord, and IBP connection cord to the multi-parameter socket on the monitor. For details, refer to the instruction manual provided with the blood pressure transducer and measuring kit.

3. Insert the catheter into the patient.

4. Perform zero balance adjustment.

5. Change necessary settings.

6. Start measurements (Start monitoring).
   After zero balance adjustment, you can start IBP measurements and monitoring.

   For handling accessories after use, refer to Section 21.

Selecting the Blood Pressure Measuring Device

Select the appropriate blood pressure measuring device according to the purpose.

WARNING

All parts, except for transducers, must be non conductive. Otherwise, the discharged energy may cause electrical shock to the operator during defibrillation.

CAUTION

- **Check that there are no scratches on the catheter balloon before use.**
- **Do not reuse disposable parts and accessories.**

Blood Pressure Transducers

*1 These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

*2 These parts are discontinued.

Nihon Kohden and Becton Dickinson (Ohmeda) Reusable Blood Pressure Transducers

Pressure Transducer	IBP Connection Cord	Measuring Kit			Other Parts		Dome	Fixing Device
		Monitoring Kit	Extension Tube	Pressure Tubing	Flush Device	Criti Flo		Transducer Holder
TP-400T*1 (Nihon Kohden)	JP-910P	SCK-520*1	TY-015U*1*2 TY-030U*1*2 TY-060U*1*2 TY-090U*1*2 TY-120U*1*2 TY-150U*1*2	PT-06 PT-12 PT-24 PT-36 PT-48 PT-60	TY-421U*1*2	TA-4004 TA-4005*1	TY-410U*1 TA-1011*1 TA-1011D*1 TA-1015T TA-1010ND	ZY-101U*1 ZY-101U*1 + adapter 2
P-23XL1	JP-900P							
P-10EZ1	JP-900P	SCK-512*1 SCK-560					TA-1017M TA-1019M TA-1017 TA-1018*1 TA-1019*1	TBG*2 TBG2 TMM UMM

Becton Dickinson (Ohmeda) Disposable Blood Pressure Transducers (DX Series)

Monitoring Kit DX Series	IBP Connection Cord	Other Parts	Fixing Device
DX-100*1	JP-900P	—	TBG*2 TBG2 TMM UMN
DX-200*1			
DX-300*1			
DX-312*1			
DX-360*1			
DX-360R*1			
DX-360TT*1			
DX-360SD*1		Safe needle TA-BPN + arterial blood sampler QS-90	
SCKD-5005*1		—	

Baxter Disposable Blood Pressure Transducers (TruWave)

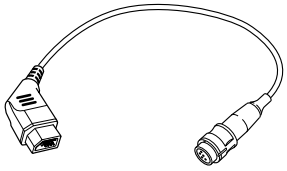
Baxter blood pressure transducers are available direct from Baxter Healthcare Corporation (www.baxter.com) or their suppliers.

Monitor Kit	IBP Connection Cord	Fixing Device
MN12030US(TW)*1	JP-920P	59-UH4 59-DTS-C
MN12030UW(TW)*1		
MN12030UT(TW)*1		
MP-5100(TW)*1		
MP-5200(TW)*1		

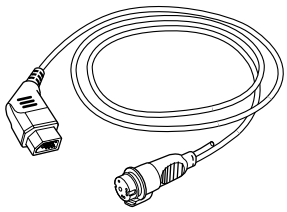
IBP Connection Cords

The IBP connection cord connector has a memory chip for saving site label and zero balance adjustment values. Attach the blood pressure site label of the saved site.

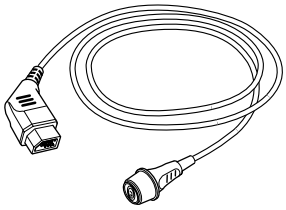
JP-910P
For Nihon Kohden and Becton Dickinson (Ohmeda) reusable blood pressure transducers

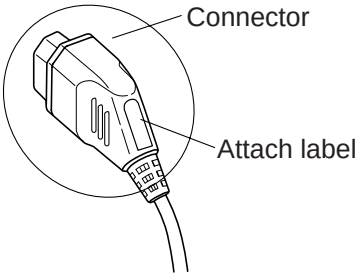


JP-900P
For Becton Dickinson (Ohmeda) reusable and DX series blood pressure transducers

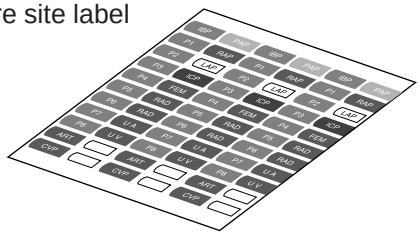


JP-920P
For Baxter disposable blood pressure transducers



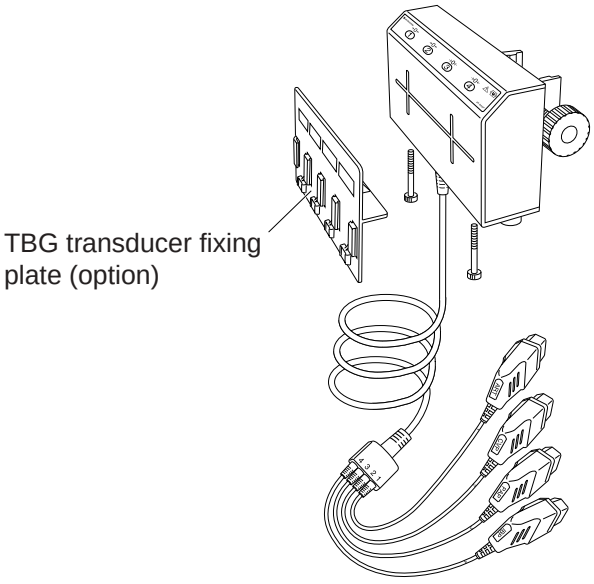


Blood pressure site label



JP-940P IBP Connection Box

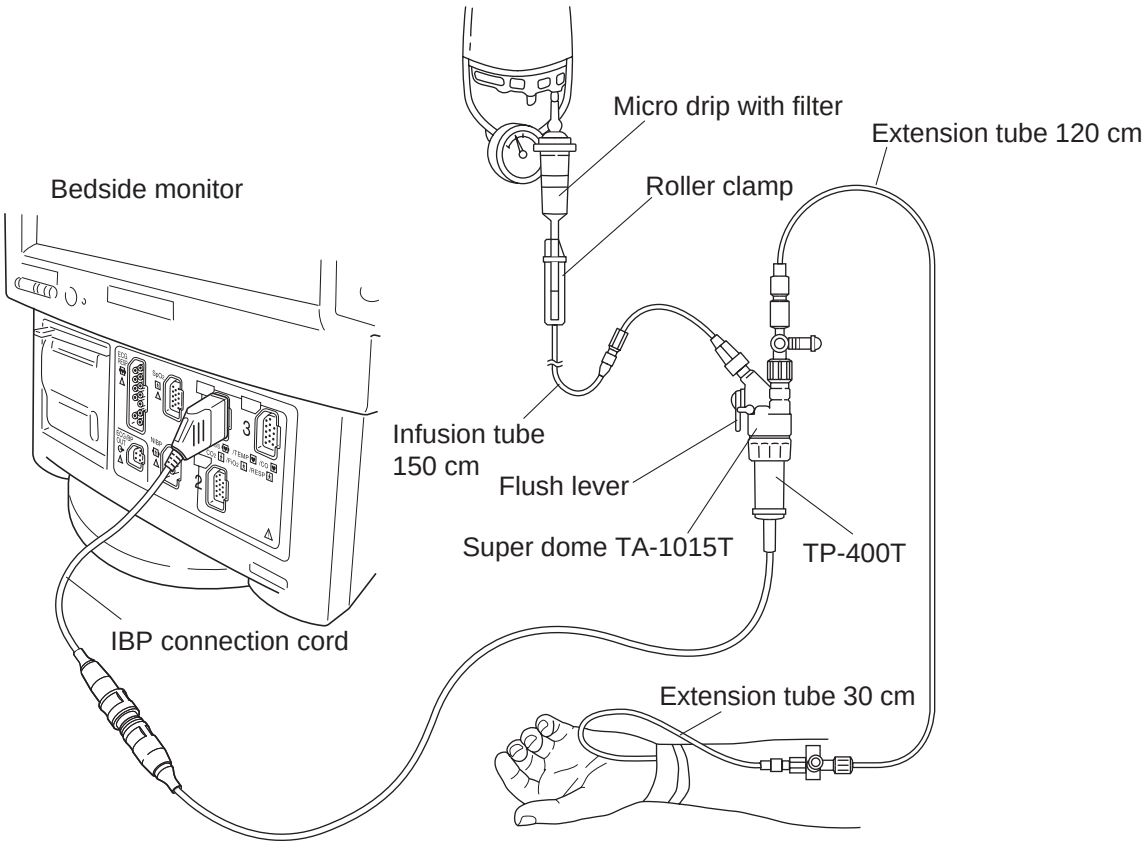
For connecting a Becton Dickinson's Life Kit DX series disposable blood pressure transducer to the monitor. An optional TBG transducer fixing plate is required.



Installing the Blood Pressure Measuring Device

The following describes installing the TP-400T blood pressure transducer and SCK-520 monitoring kit. When using other blood pressure transducers and measuring kits, refer to the respective instruction manuals.

Typical Configuration Example



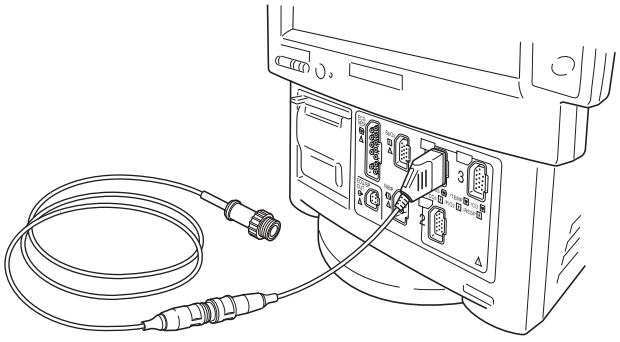
Connecting Cables to the Monitor

1. Connect the blood pressure transducer to the IBP connection cord.

2. Connect the IBP connection cord to the multi-parameter socket on the monitor.

NOTE

When using the blood pressure pulse as a sync sound or output signal of invasive blood pressure as a sync signal of the IABP (intra-aortic balloon pump) device, use the multi-parameter 1 socket on the monitor. Other sockets cannot output blood pressure signals.



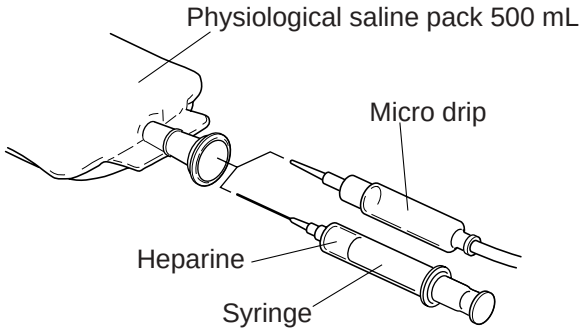
Assembling the Infusion Circuit

WARNING

- **Do not use an expired saline pack.**
- **Do not use a blood pressure monitoring kit from a torn package.**
- **Vent out any air inside the saline pack by squeezing the saline pack. Otherwise, the air will cause an error in the blood pressure data and can enter the patient's blood vessel.**

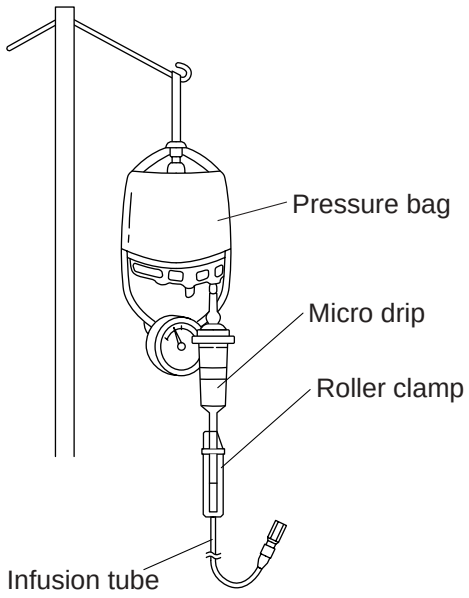
NOTE

- **To add heparin, insert the syringe needle straight into the rubber cap of the pack. If you make another needle hole in the rubber cap, it will leak even though the hole is quite small.**
- **Use the mixed solution as soon as possible without storing or saving it.**



1. Inject 1000 units of heparin into 500 mL sterilized physiological saline solution and mix well.

2. Close the roller clamp and insert the needle at the tip of the micro-drip into the hole on the physiological saline pack through which heparin was injected.



3. Check that the roller clamp is closed. Press the micro-drip lightly several times, to fill the solution in the micro-drip to about 1/3 full.

4. Open the roller clamp and completely fill the infusion tube with saline solution.

NOTE

Fill completely with saline solution so that there are no air bubbles in the infusion tube.

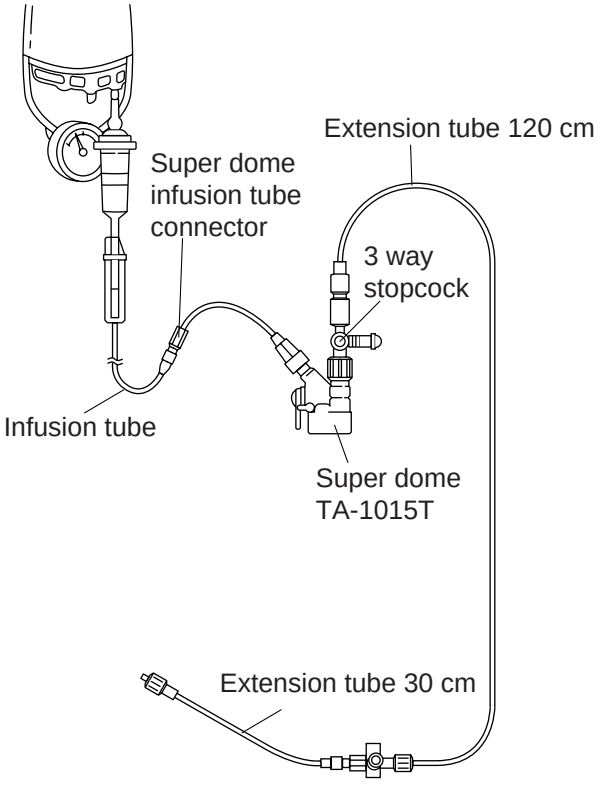
5. Place the saline pack in the pressure bag and hang the pressure bag on the stand.

6. Eliminate air bubbles in the tube completely. With the saline solution overflowing from the tip of the infusion tube, close the roller clamp.

Connecting the Dome to the Infusion Circuit

CAUTION

- **Do not leave bubbles in the flushed dome and extension tube because they will distort the blood pressure waveform.**
- **Carefully flush the tube joints because bubbles tend to remain in the joints.**
- **Do not pressurize the pressure bag until bubbles are removed from both the dome and the extension tubes.**

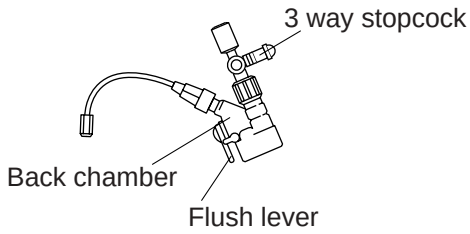


1. Connect the infusion tube to the super dome infusion tube connector.

NOTE

Make sure that air bubbles do not enter the infusion tube when connecting.

2. Open the 3-way stopcock and expose the extension tube to air.



3. Tilt the super dome as shown in the figure.

4. Open the roller clamp, and push the flush lever gently to fill the back chamber of the super dome with saline solution.

NOTE

When filling the back chamber with saline solution by applying pressure to the pressure bag, do not press the flush lever because this will produce air bubbles in the back chamber.

5. After completely filling the back chamber with saline solution, press the flush lever again so that the saline solution flows into the super dome and extension tube. Completely eliminate air bubbles in all circuits with the fluid overflowing from the tip of the extension tube.

NOTE

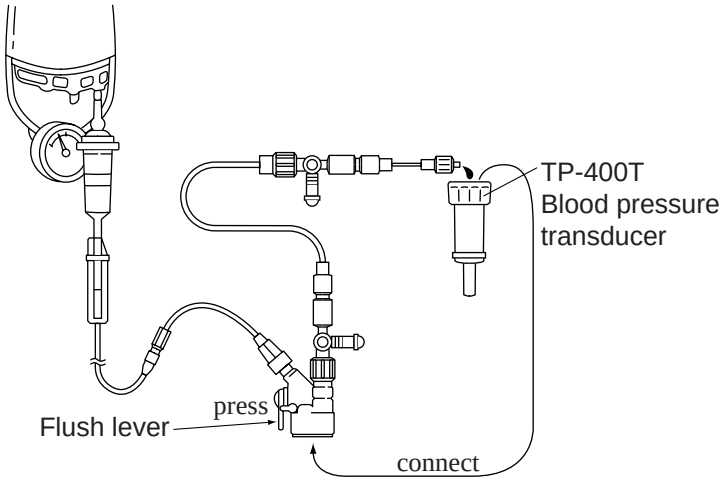
Completely eliminate the air bubbles in all circuits.

- If the air bubbles cannot be eliminated:
  1) Remove the infusion tube from the super dome.
  2) While pressing the flush lever, shake the super dome and remove all saline solution from inside the super dome completely.
  3) Repeat the procedure from step 6 in the “Assembling the Infusion Circuit” section.

6. Pressurize the pressure bag to 300 mmHg.
   At this pressure, the super dome has a flow rate of 2 to 4 mL/hr.
   Check that the solution level of the micro-drip is not too high when pressurized.

   If too high, remove the infusion tube from the super dome, and repeat the procedure from step 2 in the “Assembling the Infusion Circuit” section.

Connecting the Blood Pressure Transducer to the Dome



1. Press the flush lever so that the saline solution drips from the tip of the extension tube and saturates the membrane of the blood pressure transducer.

2. Connect the blood pressure transducer to the super dome so that the membrane of the blood pressure transducer and dome align.

3. Check all connections.

NOTE

After connecting, check that the blood pressure transducer and dome membrane are completely sealed. Measurements cannot be performed correctly if there are air bubbles or spaces between them.

Adjusting Zero Balance

Adjust zero balance in the following cases. Zero balance adjustment is important for accurate IBP measurement.

- Before starting measurements.
- When the patient moved so that the height of the heart changed.
- When the height of the blood pressure transducer changes.
- When changes in the measured value are expected due to measurements over a long period of time or due to changes in the ambient temperature (check the pressure when exposed to air).

Zero Balance Mode

There are two modes for adjusting zero balance.

- **All zero**

  The zero balance of all the blood pressure lines exposed to air, except for ICP, is performed at the same time.

  To perform zero balance for all pressure lines, ALL ZERO must be assigned to one of the function key. Refer to “Assigning a Function to the Function Key” in Section 4.

  Touch the “ALL ZERO” key at the upper left corner of the screen to perform zero balance.

  Adjust zero balance separately for the ICP (intracranial pressure).

- **Individual zero**

  The zero balance is adjusted individually.

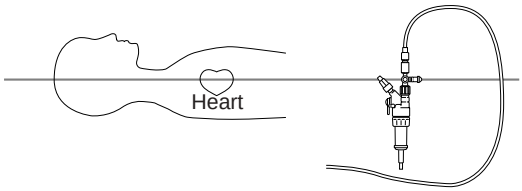
  Touch the multi-parameter socket key in the ZERO CALIBRATION box on the PRESS window.

  When using the optional JP-940P IBP Connection Box, the zero balance keys on the box can be used for each line.

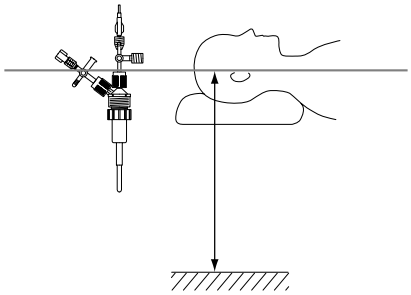
Adjusting Zero Balance

1. Move the dome up or down to position.

   The 3-way stopcock on the dome to the level of the right atrium of the patient and expose the air release opening of the 3-way stopcock to air.



   When measuring the intracranial pressure, adjust the 3-way stopcock of the catheter to the level of the ventricle and expose the air release opening of the 3-way stopcock to air.



2. Perform zero balance adjustment.

- All Zero

1) Check that ALL ZERO is assigned to one of the function key at the upper left corner of the screen. Refer to “Assigning a Function to the Function Keys” in Section 4.
2) Press the “ALL ZERO” key at the upper left corner of the screen.
3) When the “ZEROING COMPLETE” message is displayed on the screen, zero balance adjustment is completed.

- Individual Zero

1) Press the MENU key on the front panel to display the MENU window.

2) Touch the “PRESS” key. The PRESS window appears.

3) Touch the multi-parameter key in the ZERO CALIBRATION box corresponding to the multi-parameter socket connected to the blood pressure line that you want to zero balance.

4) When the “ZEROING COMPLETE” message is displayed, zero balance adjustment is completed.

3. Close the 3-way stopcock.

After adjusting zero balance and closing the 3-way stopcock, IBP is ready to be measured. The IBP value and blood pressure waveform appear on the screen.

Memorizing the Zero Balance Values

The zero values are saved in memory in the connector of the IBP connection cord when zero balance is performed. Therefore, you don’t need to adjust the zero balance again when connecting the IBP connection cord to a different multi-parameter socket.

Monitoring IBP

When the 3-way stopcock is closed after zero balance, you can start IBP monitoring.

CAUTION

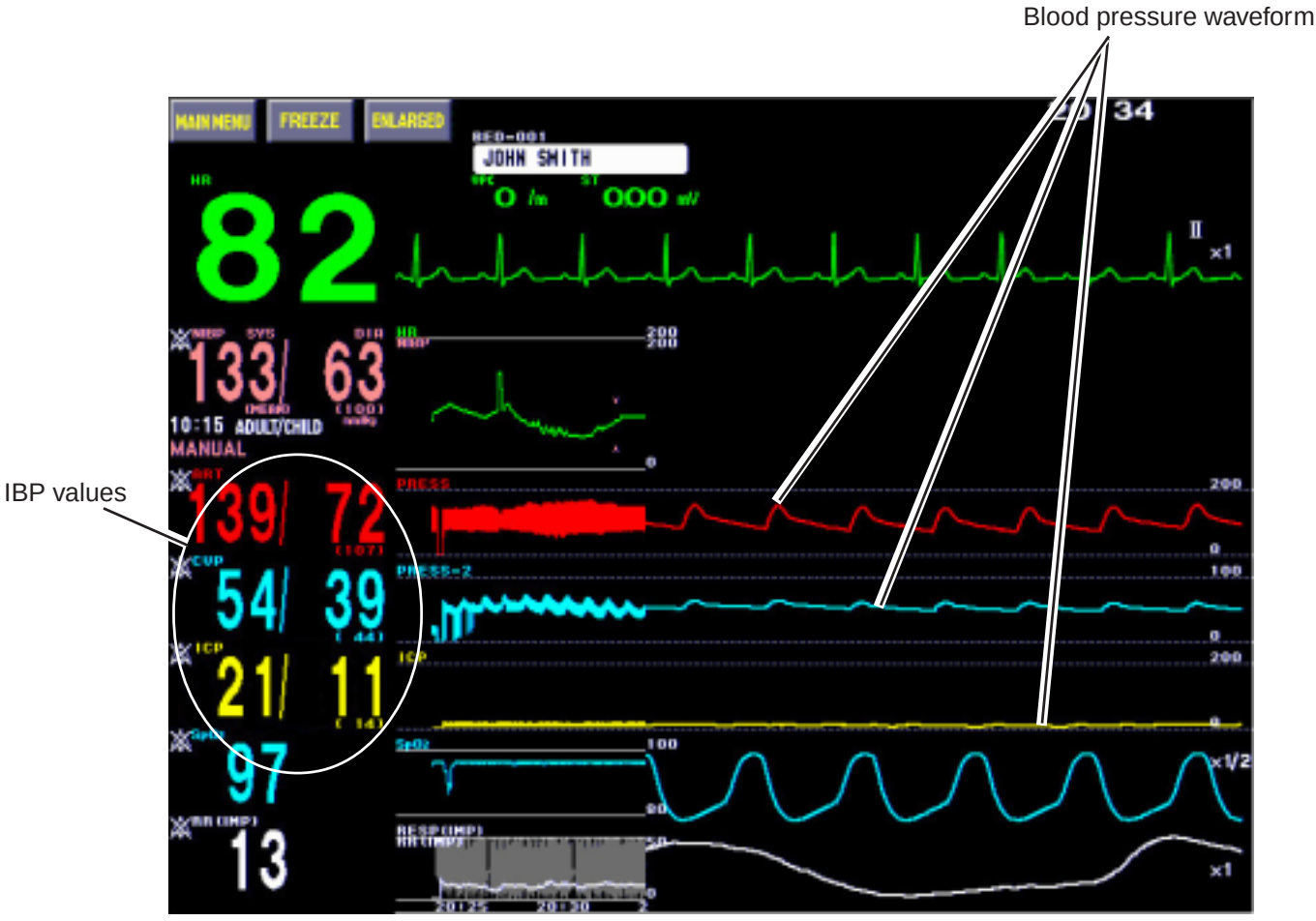
Turn off the power of cellular telephones, small wireless devices and other devices which produce strong electromagnetic interference. Otherwise, the waveforms and measurements are affected by such interference and the displayed data may be incorrect.

For error messages and monitoring problems, refer to Section 20.

IBP Information on the Monitoring Screen

The blood pressure waveform and scale correspond to the color of the IBP values displayed.

There are two ways of displaying the IBP waveforms, COMMON and SEPARATE. Change the scale mode on the SYSTEM SETUP screen. Refer to Section 3.



Changing IBP Settings

NOTE

To change settings for monitoring IBP, the IBP connection cord must be connected to the multi-parameter socket.

Change settings on the PRESS window. The following settings can be changed for monitoring IBP.

- Scale
- IBP alarm limits
- Sync source
- Sync sound pitch
- IBP calculation mode
- Numeric data display mode
- Waveform display mode
- Label

The following items can be set on the SYSTEM SETUP screen. Refer to Section 3.

- Noise filter
- Unit (mmHg or kPa)

Changing the IBP Scale

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “PRESS” key. The PRESS window appears.

3. Touch the “P1 SCALE”, “P2 SCALE” or “P3 SCALE” tab to select the channel to change the scale.

4. Select the scale by touching the desired scale key.

5. Repeat steps 3 and 4 to change the scale for other channels.

HOME

6. Press the HOME key on the front panel to return to the monitoring screen.

Changing the IBP Alarm Limits

CAUTION

When the upper or lower alarm limit is turned off, there will be no IBP upper or lower alarm for that limit.

You can set the upper and lower IBP alarm limits on this window. Other alarm items must be set on the VITAL ALARM window. You can set all alarms, including the upper and lower BP alarm limits, on the VITAL ALARM window (See Section 6).

Set P1 alarm on the P1 ALARM window, P2 alarm on the P2 ALARM window and P3 alarm on the P3 ALARM window.

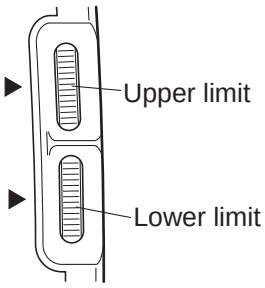
MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “PRESS” key. The PRESS window appears.

3. Touch the “P1 ALARM”, “P2 ALARM” or “P3 ALARM” tab to select the channel to change the alarm limit.

4. Touch the SYS, DIA or MEAN alarm setting bar to change the setting.



5. Use the function dials on the front panel to change settings.

   Or,

   1) Touch the upper limit box to set the upper limit or touch the lower limit box to set the lower limit.

   2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   Or,

   Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum or the lower limit is set to a value below the minimum, the alarm is set to OFF.

6. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Sync Source

You can select ECG, SpO_2 pulse (SpO_2) or arterial blood pressure pulse (P1) as the sync source.

When pulse wave and pressure waveform are irregular because of an IABP, select ECG.

When heart rate is unstable because of an electrosurgical unit, select SpO_2 or P1.

NOTE

When the sync source is set to SpO_2 or P1 and the SpO_2 or BP of the multi-parameter 1 socket monitoring is interrupted, the sync source changes to ECG automatically. The sync source returns to SpO_2 or P1 when the SpO_2 or BP is monitored again.

When the sync source is set to ECG and ECG is not measured, there is no sync sound.

When SpO_2 or P1 is selected, the pulse rate is displayed instead of the heart rate on the screen.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “PRESS” key. The PRESS window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “ECG”, “SpO_2” or “P1” key in the SYNC SOURCE box to select the sync source.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Selecting Sync Sound Pitch

The sync sound can be variable pitch or fixed pitch pips. The fixed pitch is high pitch as the default, but medium or low pitch can also be set. See Section 3. When you select variable pitch, the pitch of the sync sound changes according to SpO_2 value or systolic BP value of the arterial blood pressure.

When the variable pitch with SpO_2 value is selected, the pitch of the sync sound changes as follows.

SpO2 Value	Pitch of Sync Sound
100 to 81%	High to low pitch, in 1% steps
Less than 81%	Low pitch

When the variable pitch with systolic BP value is selected, the pitch of the sync sound changes as follows.

Systolic BP Value	Pitch of Sync Sound
Higher than 120 mmHg	High pitch
120 to 20 mmHg	High to low pitch, in 5 mmHg steps
Less than 20 mmHg	Low pitch

When the sync source is set to P1 and the “CHECK SENSOR” message appears on the screen, the sync sound stops.

When the sync source is set to ECG or SpO_2, the sync pitch is set to P1 and the “CHECK SENSOR” message appears on the screen, the low pitch is selected automatically.

When the SpO_2 connection cord or IBP connection cord is disconnected from the monitor, ECG is automatically selected as the sync source.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “PRESS” key. The PRESS window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “FIXED”, “SpO_2” or “P1” key in the SYNC PITCH box to select the sync pitch.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Selecting the Mode for Calculating IBP

There are two calculation modes for displaying the IBP values.

STANDARD: The IBP values are calculated by moving average. The monitor averages the latest 8 consecutive pulses and displays this average as the IBP value. When a new pulse is detected, the IBP value is recalculated using the latest 8 pulses. The IBP value display is updated every 3 seconds.

PEAK: The systolic, diastolic and mean values of the highest pulse wave in the latest 8 consecutive pulses are displayed as the IBP values. The IBP value display is updated every 3 seconds.

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “PRESS” key. The PRESS window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “STANDARD” or “PEAK” key in the CALCULATION METHOD box.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Waveform Display Mode

There are two ways to display IBP waveforms on the monitoring screen.

COMMON: All IBP waveforms are displayed on the same scale.
SEPARATE: IBP waveforms are displayed separately on different scales.

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “PRESS” key. The PRESS window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Select the IBP waveform display mode from the PRESS SCALE box.

5. Press the HOME key on the front panel to return to the monitoring screen.

Selecting the Numeric Data Display Mode

The display mode of the IBP values can be selected for the monitoring screen. Select this display mode for every blood pressure line.

S/D (M): Displays the systolic blood pressure (S), diastolic blood pressure (D) and the averaged blood pressure (M).

M: Displays only the averaged blood pressure.

When “M” is selected, systolic and diastolic values appear on the screen when a systolic or diastolic alarm occurs.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “PRESS” key. The PRESS window appears.

3. Touch the “OTHER SETTING” tab to display the OTHER SETTING window.

4. Touch the “S/D (M)” or “M” key for each blood pressure line in the NUMERIC DISPLAY box.

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Label

Label the site name of the blood pressure line to be identified by the monitor. At shipment, the blood pressure lines are labeled PRESS, PRESS-2 and PRESS-3. You can use these, but it is recommended to label the site properly for proper processing of the waveform.

The labels are saved in memory in the connector of the IBP connection cord. Once the label is set, you don't need to set the label again when the IBP connection cord is connected to a different multi-parameter socket on the monitor.

Setting labels is important for the following reasons.

- Prevents confusion of the blood pressure lines
- Measures the PCWP (Pulmonary Capillary Wedge Pressure) from the PAP (Pulmonary Artery Pressure).
- Lists the ART (Arterial Pressure), PAP (Pulmonary Artery Pressure), and CVP (Central Venous Pressure) values in the hemodynamics list.
- The display area of the blood pressure line measured is determined by the priority of the labels.
- The pulse rate is counted according to the priority of the blood pressure labels.

Types of Labels

There are 13 labels.

ART:	Arterial Pressure
	Up to 2 blood pressure lines (ART and ART-2) can be set.
RAD:	Radial Artery Pressure
DORS:	Dorsal Artery Pressure
AO:	Aortic Pressure
FEM:	Femoral Artery Pressure
UA:	Umbilical Artery Pressure
UV:	Umbilical Vein Pressure
PAP:	Pulmonary Artery Pressure
CVP:	Central Venous Pressure
RAP:	Right Atrial Pressure
RVP:	Right Ventricular Pressure
PRESS:	Others
	Up to 3 blood pressure lines (PRESS, PRESS-2 and 3) can be set.
ICP:	Intracranial Pressure
	Up to 3 pressure lines (ICP, ICP-2 and ICP-3) can be set.

When using the PRESS labels, PRESS can only be used for the blood pressure line connected to the multi-parameter 1 socket, PRESS-2 can only be used for the blood pressure line connected to the multi-parameter 2 socket and PRESS-3 can only be used for the blood pressure line connected to the multi-parameter 3 socket.

Changing the Labels

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “PRESS” key. The PRESS window appears.

3. Touch the “LABEL” tab to display the LABEL window.

4. Touch the multi-parameter key corresponding to the multi-parameter socket to which the IBP connection cord of the blood pressure line you want to label is connected.

5. Select the label appropriate for the blood pressure line.

6. Repeat steps 4 and 5 to change the label for another blood pressure line.

HOME

7. Press the HOME key on the front panel to return to the monitoring screen.

8. Attach the blood pressure site label to the connector of the IBP connection cord.

Section 16 Temperature Monitoring

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Reusable Probes 16.2
Disposable Probe 16.3
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Changing the Label 16.10
Types of Labels 16.11
Types of Labels for Blood Temperature Measured Regions 16.11
Changing the Label 16.11

General

Temperature can be monitored by attaching the probe to the patient and using the multi-parameter socket on the monitor.

Two probes can be connected to one temperature connection cord to measure 2 channels.

By using the CO connection cord and catheter, the blood temperature of one channel can be measured. (Refer to Section 17.)

Preparing for Temperature Monitoring

Preparation Flowchart

1. Select the probe.
2. Connect the probe to the temperature connection cord and connection cord to the multi-parameter socket on the monitor.
3. Attach the probe to the patient.
4. Change necessary settings.
5. Start monitoring.

   For handling accessories after use, refer to Section 21.

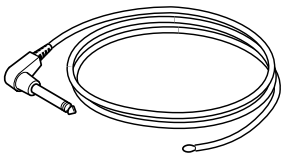
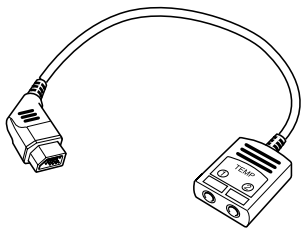
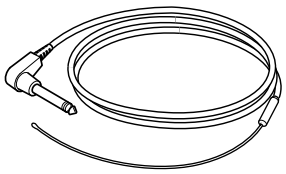
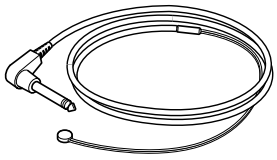
Selecting the Probe

Select the appropriate probe according to the purpose.

CAUTION

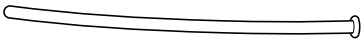
Select the appropriate probe for the patient. Using adult probes on premature infants and children may injure the mucous membrane.

Reusable Probes

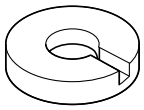
Thermistor Probe	Purpose	Temperature Connection Cord
YSI-401JG* 	For adult rectum/esophagus	JT-900P 
YSI-402JG* 	For child rectum/esophagus	
YSI-409JG* 	For body surface	

* These thermistor probes are available direct from YSI, Yellow Springs Instrument CO., Inc., Yellow Springs Ohio 45387, USA; Phone +1 513-767-7241.

YSI-401JG comes with a probe cover**.



YSI-409JG comes with an insulation pad**.



** These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Disposable Probe

The following probes can be used on this monitor. To use the disposable probes, the JT-900P temperature connection cord and 5-15801 extension cable are required.

The disposable probes and the extension cable are available direct from Kendall Healthcare Products Company (www.kendallhq.com) or their suppliers.

CAUTION

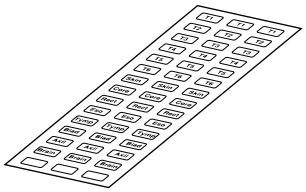
Do not reuse disposable probes on other patients.

Disposable Probe		Thickness	Purpose
Sonatemp	5-13212**	12F	For esophagus
	5-13218**	18F	
	5-13224**	24F	
Sheritemp	5-15610**	18F	For esophagus/rectum
Sheritemp	5-16201**	—	For body surface
Sheritemp	5-26101**		For tympanic membrane
Foley catheter	5-18808**	8F	For bladder
	5-18810**	10F	
	5-18812**	12F	
	5-18814**	14F	
	5-18816**	16F	
	5-18818**	18F	

** These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Temperature Connection Cord

The temperature connection cord connector has a memory chip for saving the site label. Attach the temperature site label of the saved site.



Temperature site label

Connecting Cables and Attaching the Probe

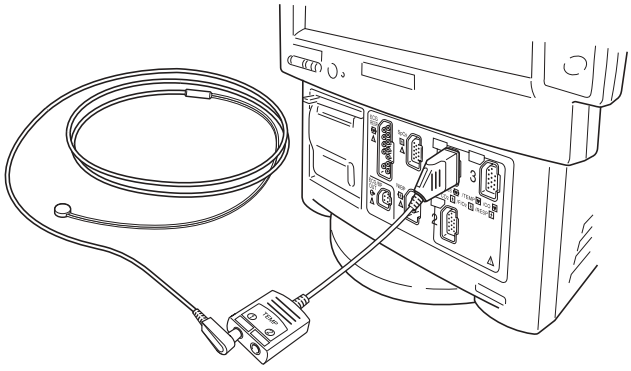
Connecting Cable to the Monitor

1. Connect the probe to the temperature connection cord.

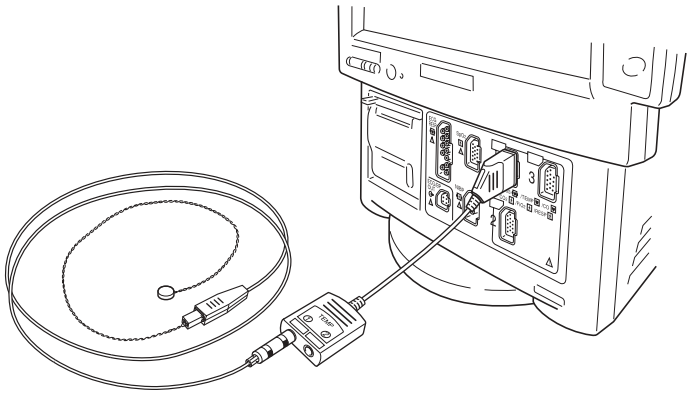
   When using the disposable probe, connect the extension cable between the probe and temperature connection cord.

2. Connect the temperature connection cord to the multi-parameter socket on the monitor.

Connecting the YSI-409JG reusable probe for the body surface



Connecting the disposable probe (Sheritemp body surface:5-16201)



Attaching the Probe to the Patient

CAUTION

Select the appropriate probe for the patient. Using adult probes on premature infants and children may injure the mucous membrane.

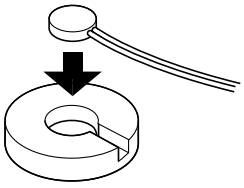
NOTE

For details on how to attach the probe, refer to the probe instruction manual.

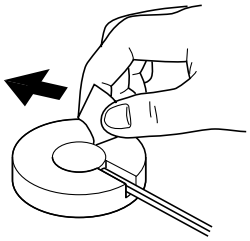
Attaching Probe to the Body Surface

CAUTION

The insulation pad may irritate the skin. In long term monitoring, change the attachment site.

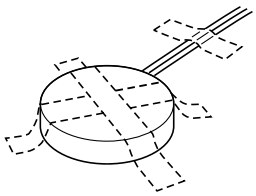


1. Put the sensor probe on the insulation pad.



2. Remove the backing paper from the insulation pad.

3. Attach the probe to the patient.



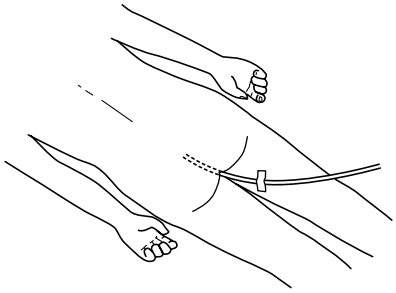
To measure the peripheral temperature, attach the probe to the ankle or palm. If the patient sweats heavily or moves violently, fasten the pad with surgical tape.

Using the insulation pad

The pad prevents the environmental temperature from affecting the sensor temperature and also prevents internal body heat from escaping at the attached site so that a stable temperature is obtained.

NOTE

When the measuring site is exposed directly to air, the temperature may be lower than normal. It takes about 20 to 30 minutes to reach the equilibrium temperature after attaching the sensor.

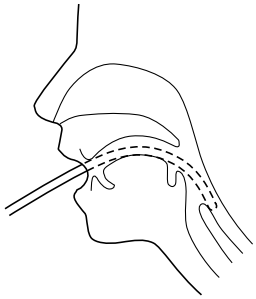


Inserting the Probe into the Rectum

1. Attach the probe cover to the tip of the probe for the rectum. If you have no probe cover, apply lubricating agent on the tip of the probe.

2. Insert the probe 3 to 7 cm into the rectum.

3. Fasten the probe cable to the skin using surgical tape.



Inserting the Probe into the Esophagus

Insert the probe for the esophagus into the esophagus through the nostrils or mouth.

For adults, insert 22 to 26 cm from the incisor teeth.

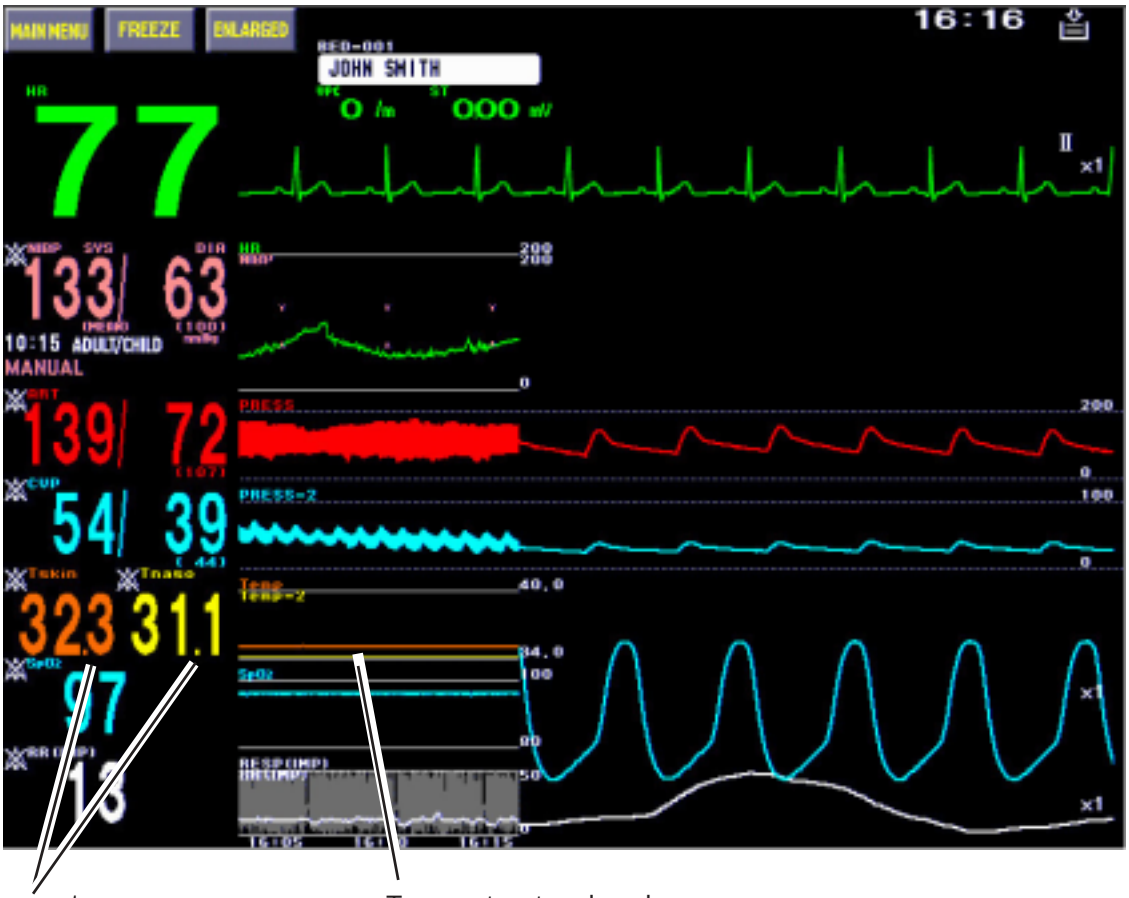
Monitoring Temperature

After completing the preparation, temperature data appears on the screen.

Select T1&T2 or T1& delta T for temperature display on the TEMP window. Refer to the “Changing the Temperature Display Mode” section.

For error messages and monitoring problems, refer to Section 20.

Temperature Information on the Monitoring Screen



When the blood pressure waveform display mode is set to COMMON on the PRESS or DISPLAY window, the temperature trendgraph is not displayed.

Changing Temperature Settings

NOTE

To change settings for monitoring temperature, the temperature connection cord must be connected to the multi-parameter socket.

Change settings on the TEMP window. The following settings can be changed for monitoring temperature.

- Temperature display mode
- Temperature alarm limits
- Label

The temperature unit can be set to °C or °F on the SYSTEM SETUP screen. Refer to Section 3.

Changing the Temperature Display Mode

Either "T1 & T2" or "T1 & delta T" can be selected for the temperature display mode.

T1 & T2: Displays T1 and T2
T1 & delta T: Displays T1 and the temperature difference between T1 and T2.

When a temperature alarm occurs, the display mode automatically changes to the mode which displays that parameter. For example, when the mode is set to "T1 & delta T" and T2 alarm occurs, the mode changes to "T1 & T2".

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "TEMP" key. The TEMP window appears.

3. Touch the “T1 & T2” or “T1 & delta T” in the TEMPERATURE SETTING box.

HOME

4. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Temperature Alarm Limits

CAUTION

When the upper or lower alarm limit is turned off, there will be no temperature upper or lower alarm for that limit.

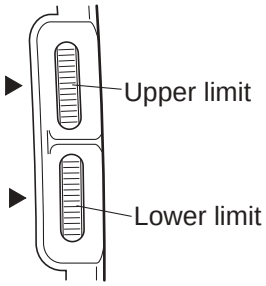
You can set the upper and lower temperature alarm limits on this window. Other alarm items must be set on the VITAL ALARM window. You can set all alarms, including the upper and lower temperature alarm limits, on the VITAL ALARM window (See Section 6).

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “TEMP” key. The TEMP window appears.

3. Touch an alarm setting bar to change the setting.



4. Use the function dials on the front panel to change settings.

   Or,

   1) Touch the upper limit box to set the upper limit or touch the lower limit box to set the lower limit.

   2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   Or,

   Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   If the upper limit is set to a value above the maximum or the lower limit is set to a value below the minimum, the alarm is set to OFF.

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Label

Label the measuring site to be identified by the monitor.

At shipment, the sites are labeled as Temp. You can use this label but it is recommended to label the sites to be measured.

The labels are saved on memory in the connector of the temperature connection cord. Once the label is set, you don't need to set the label again when the temperature connection cord is connected to a different multi-parameter socket.

Types of Labels

There are 9 types of labels.

Tskin: Skin temperature
Up to 2 sites can be set (Tskin and Tskin-2)
Trect: Rectum temperature
Tcore: Core temperature
Tnaso: Nasal cavity temperature
Teso: Esophagus temperature
Ttymp: Tympanic membrane temperature
Tblad: Bladder temperature
Taxil: Axillary temperature
Temp: Others
Up to 2 sites can be set (Temp and Temp-2)

Types of Labels for Blood Temperature Measured Regions

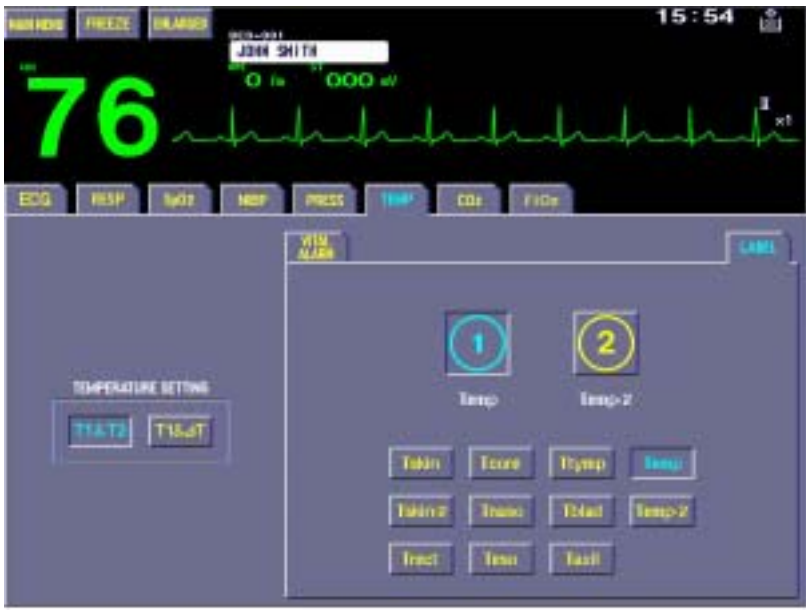
When blood temperature is measured with a catheter and CO connection cord, the label is Tb.

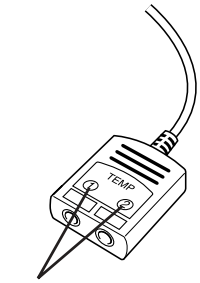
Changing the Label

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “TEMP” key. The TEMP window appears.

3. Touch the “LABEL” tab to display the LABEL window.





4. Touch the channel key to which you want to label.
5. Select the appropriate label.
6. Repeat steps 4 and 5 to change the label of the other channel.

7. Press the HOME key on the front panel to return to the monitoring screen.
8. Attach the temperature site label to the connector of the temperature connection cord.

Section 17 CO Monitoring

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General

CO (Cardiac Output) measurements are performed by connecting the measuring system to the multi-parameter socket on the monitor. This monitor uses the thermodilution method.

Thermodilution method

This method is performed by injecting cold water into the right atrium, measuring the temperature changes of the blood after mixing of the injected cold water in the right ventricle using the thermistor at the tip of a catheter, and drawing the temperature change curve (thermal dilution curve). The cardiac output is calculated from the area below this curve.

WARNING

When performing defibrillation during CO monitoring, never touch the CO connection cord. Otherwise the discharged energy may cause serious electrical burn, shock or other injury.

NOTE

CO monitoring using the multi-parameter socket does not comply with the Defibrillator proof type CF.

Assembling the Measuring System and Inserting the Catheter into the Patient

Preparation Flowchart

1. Select the thermodilution catheter.
2. Prepare the injectate.
3. Connect the catheter to the CO connection cord and connection cord to the multi-parameter socket on the monitor, and assemble the measuring system. For details, refer to the instruction manuals provided with the catheter and measuring system.
4. Insert the catheter into the patient.
5. Measure the pulmonary capillary wedge pressure. Determine the position for retaining the catheter.
6. Check the setting for measuring CO.
7. Measure CO.

   For handling accessories after use, refer to Section 21.

Selecting the Catheter

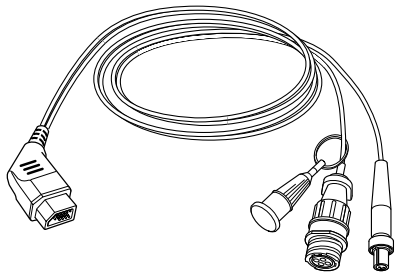
Select the appropriate catheter according to the purpose.

CAUTION

- **Check that there are no scratches on the catheter balloon before use.**
- **Do not reuse disposable products.**

Types of Catheter

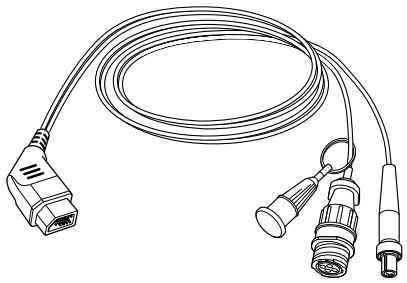
Becton Dickinson (Ohmeda) Thermodilution Catheter

Catheter	Specifications	Thickness (F)	Lumen	CO Connection Cord
TC-504*	—	5	4	JT-950P 
TC-664MP*	Made of polyurethane	6		
TC-704*	—	7		
TC-704M*				
TC-704MU*	Made of polyurethane			
TC-7042*	For inline sensor method			
TC-724*	S shaped tip			
TC-755*	—	7.5	5	
TC-774MP*	Made of polyurethane	7	4	

* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Baxter Swan-Ganz (Thermodilution) Catheter

Baxter catheters are available direct from Baxter Healthcare Corporation (www.baxter.com) or their suppliers.

Catheter	Specifications	Thickness (F)	Lumen	CO Connection Cord
131H-7F*[1]	Standard	7	4	JT-950P 
141H-7F*[1]	Hard			
151H-7F*[1]	For femoral vein			
93A-161H-7F*[1]*[2]	Hard tapered			
93A-171H-7F*[1]*[2]	Torque support			
93C-172H-7F*[1]*[2]	Made of polyurethane			
096-6F*[1]*[2]	For adult small blood vessel	6		
132-5F*[1]*[2]	For children	5		
93A-831H-7.5F*[1]*[2]	With side hole for infusion	7.5	5	
93A-931H-7.5F*[1]*[2]	With RV pace port side hole			
93A-991H-8F*[1]*[2]	With AV pace port side hole	8	6	
93A-200H-7F*[1]	RA, RV pacing electrode	7	4	
93A-205H-7F*[1]				
93A-741H-7.5F*[1]	$S\bar{v}O_2$ measurement possible.*[3]	7.5	5	

*[1]These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

*[2]In this monitor, the computation constant required for calculating CO value is automatically calculated, but not for the catheters marked with *[2]. When using these catheters, enter the computation constant labeled on the package of the catheter.

*[3]$S\bar{v}O_2$ cannot be monitored on this bedside monitor.

Preparing the Injectate

Usable Injectate

Use sterilized 5% glucose solution for the injectate. Physiological saline can also be used, but the CO value is about 2% lower than when glucose is used.

Injectate Temperature and Volume

When the injectate temperature is high or the injectate volume is small, the thermodilution curve becomes low and the measuring range is limited. Use a large volume (10 cc) of low temperature (0°C, 32°F) injectate if it does not cause any problems to the patient.

The appropriate injectate temperature and volume differs according to the catheter used. Refer to the instruction manual for the catheter used.

When the injectate temperature is 27.0 to 27.2°C (80.6 to 81°F), “27.0” is displayed for Ti on the monitoring screen. When the injectate temperature is above 27.2°C (81°F), “---” is displayed.

Measuring the Injectate Temperature

Types of Measuring Methods

Measure the temperature of the injectate using one of the following two methods.

Measuring Type	Measuring Method
Inline sensor method	Directly measures the injectate temperature at injection. The measuring accuracy is high because the temperature is measured directly.
Bath probe method	Measures the injectate temperature before injection and uses this temperature as the injectate temperature.

Preparing the Injectate

Prepare the injectate based on the following table.

Preparations	Injectate Temperature Measuring Method	Accuracy	Ease of Use	Sterilization	Running Cost
Use a closed injection kit	Inline sensor method	excellent	excellent	excellent	fair
Syringes iced in the container	Inline sensor method	excellent	good	good	fair
	Bath probe method	good	fair	fair	good
	None*	fair	good	good	good
Transfers injectate from iced injectate bottle to syringe	Inline sensor method	excellent	good	good	fair
	None*	good	excellent	good	good

*When the injectate is cooled down to 0°C (32°F).

Inline Sensor Method

When using the inline sensor method, prepare the injectate using one of the following methods.

- Using the close injection kit

  Using a close injection kit with a temperature sensor, close the circuit and inject the injectate. This method is easy and allows the monitor to determine the temperature of the injectate accurately.

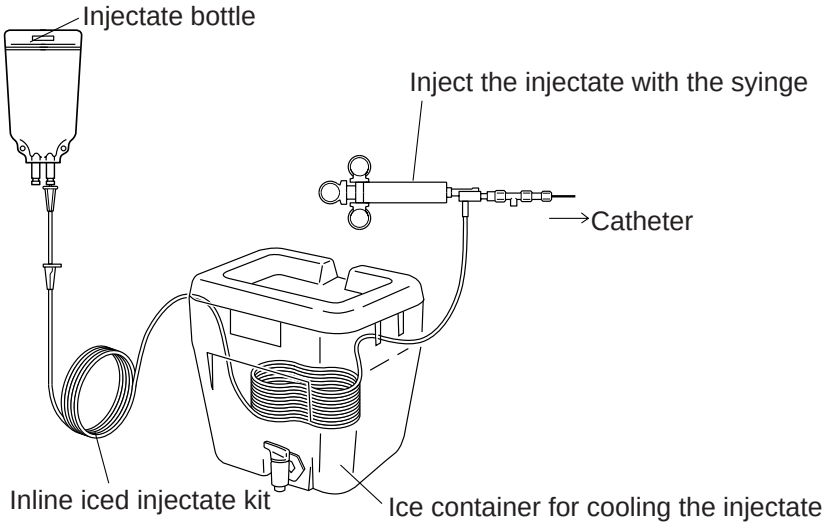
  Features

  1) Sterilization rate is very high because it is disposable and closed
  2) Measurements are accurate
  3) Easy to use (Can measure several times using one syringe)
  4) Both cooled injectate and room temperature injectate can be used and cooling time is short.

  Example

  When using the Becton Dickinson (Ohmeda) catheter: Inline iced injectate kit (SP-4500)

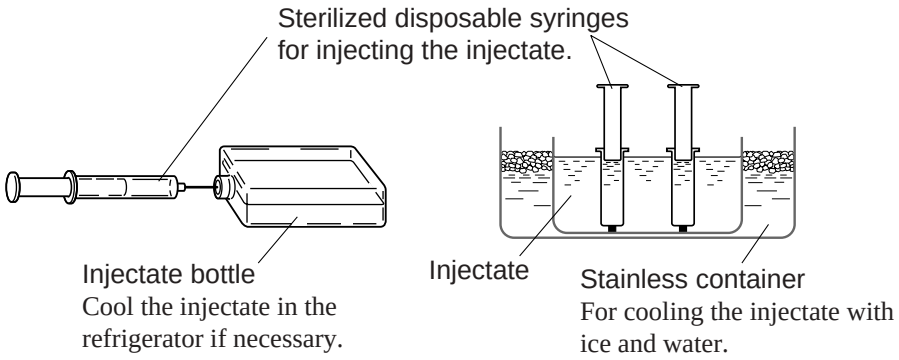
  When using the Baxter catheter: Injectate supply system (93-600, 93-610)


Injectate bottle
Inject the injectate with the syinge
Catheter
Inline iced injectate kit
Ice container for cooling the injectate
Put ice and water for cooling the injectate.

- Drawing directly from the injectate bottle or the container of the injectate
  As shown in the following diagram, draw the injectate directly from its bottle or the container containing the injectate, and inject into the circuit installing the temperature sensor. When drawing injectate from the container, wait about 15 minutes for the temperature of the injectate to reach equilibrium before injecting into the circuit.

  The temperature sensor detects the injectate temperature, and sends the data to the monitor.

  Example
  When using the Becton Dickinson (Ohmeda) catheter: Inline sensor (SP-5045)
  When using the Baxter catheter: Flow through injectate housing (93-505)

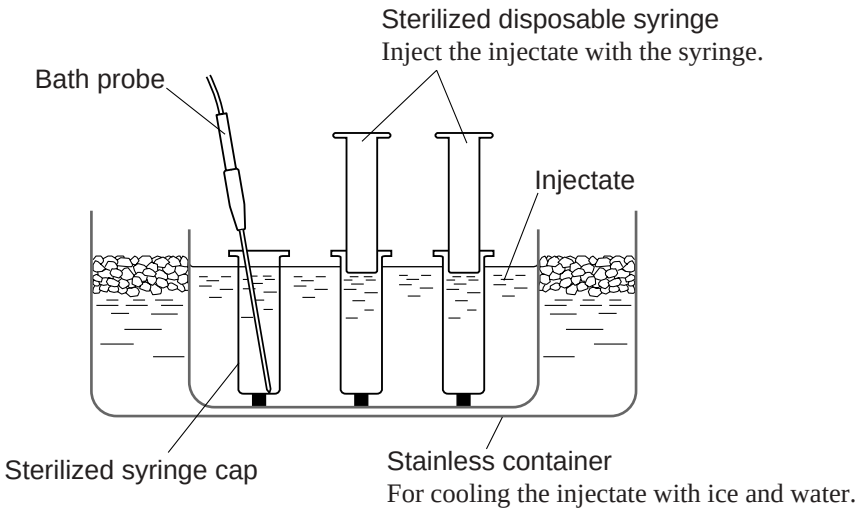

Sterilized disposable syringes
for injecting the injectate.
Injectate bottle
Cool the injectate in the refrigerator if necessary.
Injectate
Stainless container
For cooling the injectate with ice and water.

Bath Probe Method

When using the bath probe method, prepare the injectate as follows.

- Drawing the injectate from its container
  As shown in the following diagram, draw the injectate from its container and wait about 15 minutes for the injectate temperature to reach equilibrium before injecting it into the circuit.

  Place the thermistor probe (SP-5030) installed in the circuit in the container, and have the monitor determine the injectate temperature.

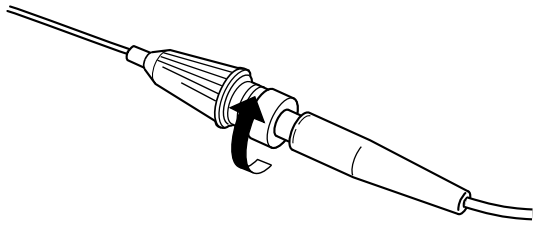


Assembling the Measuring System

Connecting Cables to the Monitor

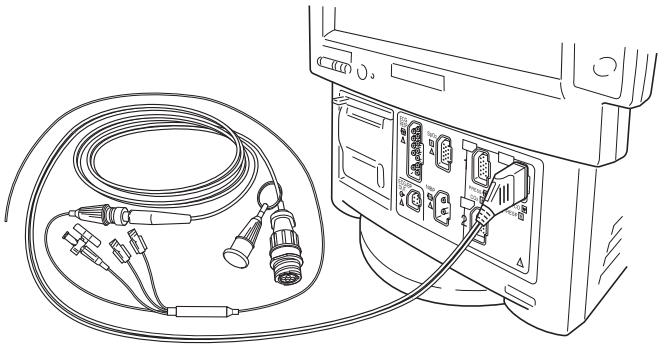
When monitoring IBP and CO at the same time, connect the IBP connection cords to the multi-parameter 1 and 2 sockets and connect the CO connection cord to the multi-parameter 3 socket on the monitor. On the BSM-4101/4102/4111/4112 monitors, connect the CO connection cord to the multi-parameter 2 socket.

1. Connect the thermistor connector of the catheter to the CO connection cord and secure it firmly with the ring.



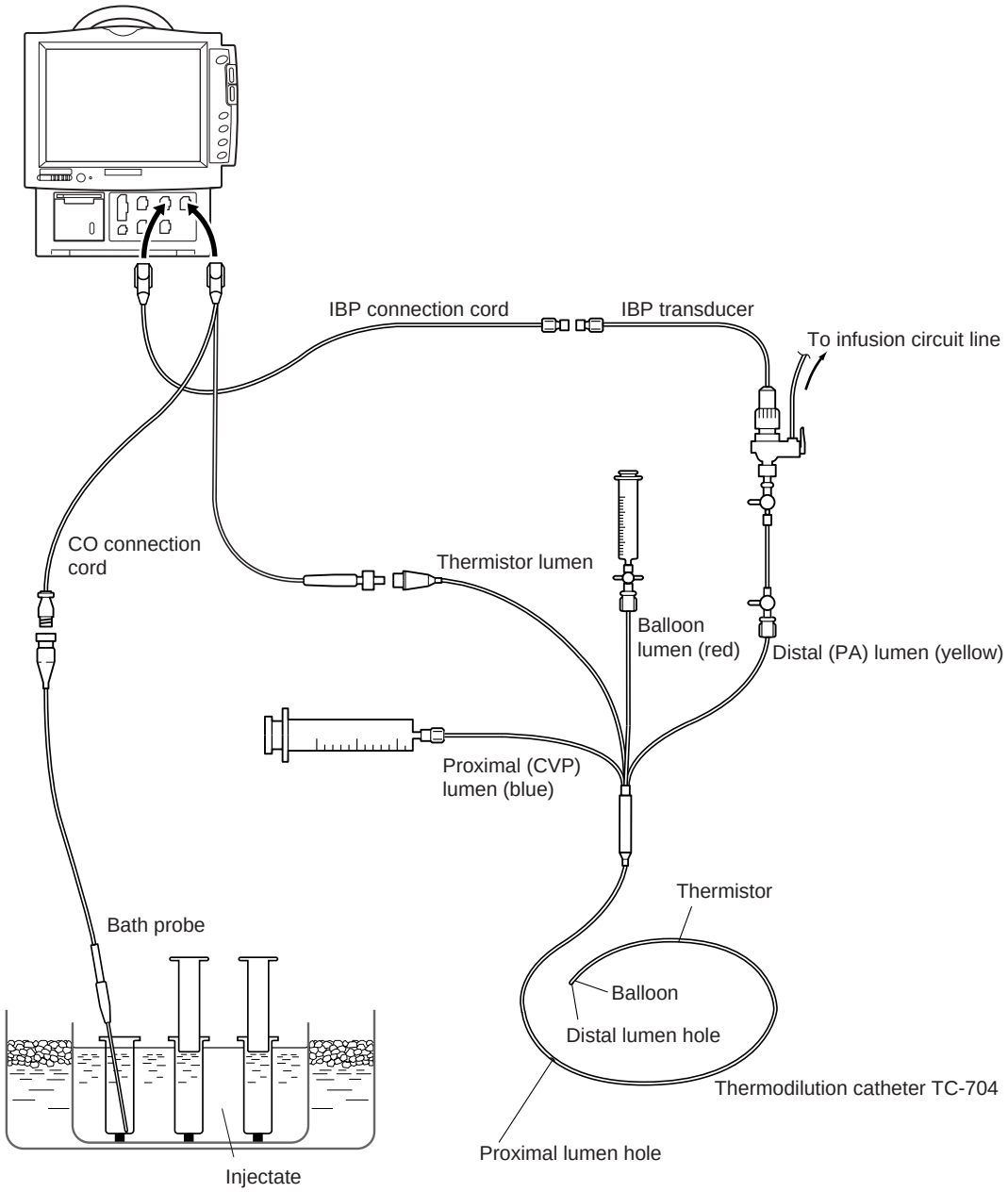
2. Connect the CO connection cord to the multi-parameter 3 socket (multi-parameter 2 socket on the BSM-4101/4102/4111/4112 monitors) on the monitor.

When connected to the Becton Dickinson (Ohmeda) Catheter TC-704

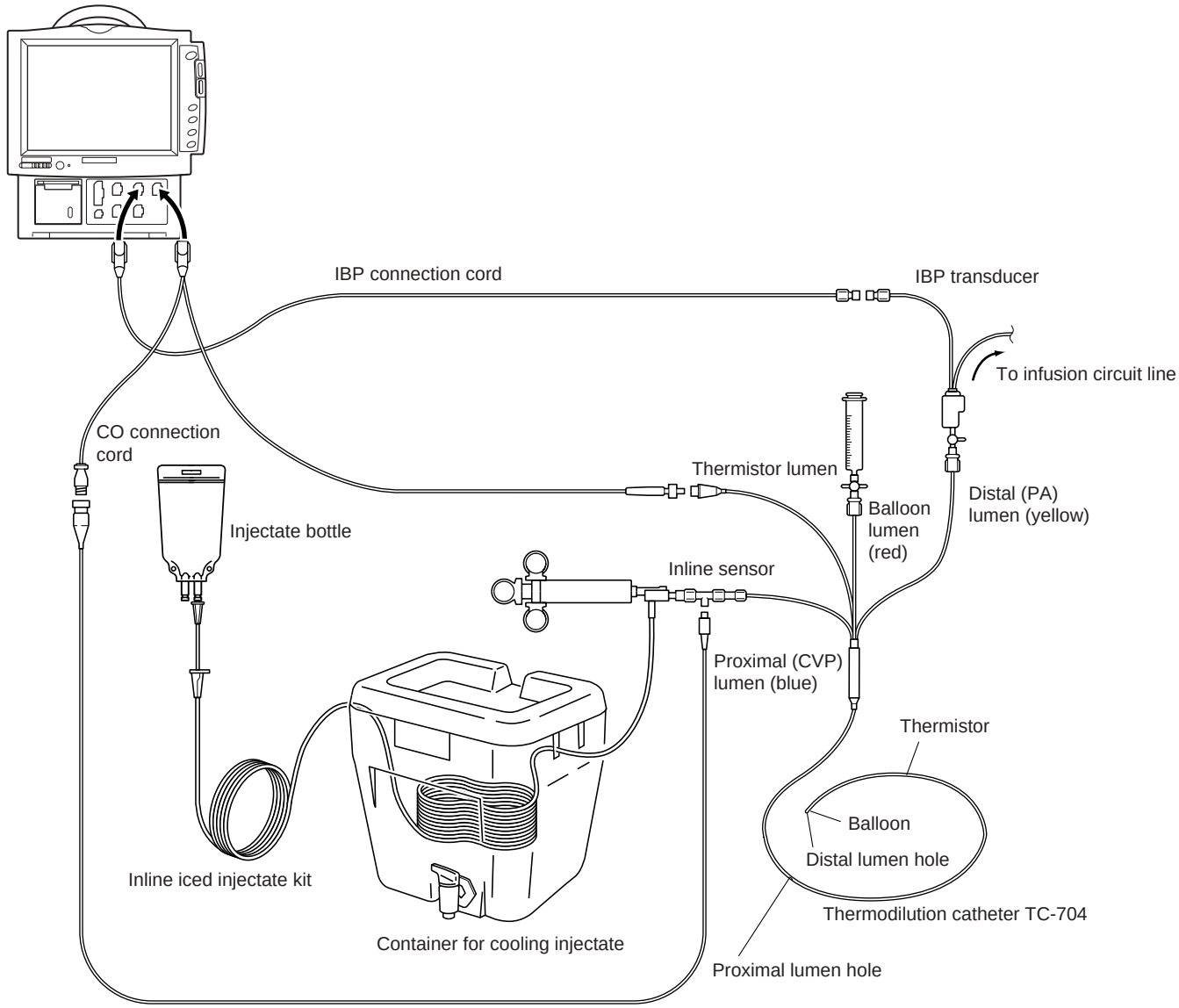


Measuring System Setup Example

When using the Becton Dickinson (Ohmeda) Catheter TC-704 and measuring with the bath probe method



When using the Becton Dickinson (Ohmeda) Catheter TC-704 and measuring with the in-line sensor method



Changing Settings for CO Measurement

Before measuring CO, the coefficient value of the catheter and patient height and weight must be entered.

Setting the Coefficient Value

This monitor automatically calculates the coefficient value from five types of information: the manufacturer of catheter, catheter size, injectate volume, injectate temperature, and method of measuring the injectate temperature.

When using a Becton Dickinson (Ohmeda) or Baxter catheter, the injectate temperature is automatically measured by this monitor. Enter the manufacturer of catheter, catheter size, injectate volume and injectate temperature as follows. After setting, check that the value is the same as the value on the catheter manual. For a Becton Dickinson (Ohmeda) catheter, the coefficient values are not specified by the manufacturer for the injectate temperature 5 to 18°C.

When using a catheter other than Becton Dickinson (Ohmeda) or Baxter, enter the computation constant manually. Check the value on the catheter manual.

When using a catheter other than bath probe or inline sensor and not setting the injectate temperature on the monitor, select coefficient value from the bath probe table. In this case, "- - -" is displayed for Ti on the screen.

Procedure

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "CO" key. The CO window appears.

3. Select the manufacturer of the catheter (Baxter or B.D (Becton Dickinson)).

4. Select the area corresponding to catheter size, method of measuring injectate temperature, and injectate volume.

   When using a catheter for which the coefficient value cannot be calculated automatically, touch the “CONSTANT” key and enter the computation constant with the numeric keys. Touch the “SET” to key to register the setting.

   The injectate temperature is detected by the monitor.

5. Check the manufacturer, sensor type, catheter size, injectate volume and constant settings. Make sure that the constant is the same as the value on the catheter manual.

The Preset Coefficient Value Settings

Becton Dickinson (Ohmeda) catheters

Injectate temperature 23 to 25°C

		7.5F	7F	6F	5F
Bath probe	10 cc	0.628	0.628	—	—
	5 cc	0.309	0.309	0.309	0.316
	3 cc	0.181	0.181	0.181	0.188
Inline sensor	10 cc	0.628	0.628	—	—
	5 cc	0.309	0.309	0.309	0.316
	3 cc	0.181	0.181	0.181	0.188

Injectate temperature 18 to 23°C

		7.5F	7F	6F	5F
Bath probe	10 cc	0.628	0.628	—	—
	5 cc	0.309	0.309	0.312	0.312
	3 cc	0.181	0.181	0.184	0.184
Inline sensor	10 cc	0.628	0.628	—	—
	5 cc	0.309	0.309	0.312	0.312
	3 cc	0.181	0.181	0.184	0.184

Injectate temperature 0 to 5°C

		7.5F	7F	6F	5F
Bath probe	10 cc	0.566	0.566	—	—
	5 cc	0.270	0.270	0.270	0.279
	3 cc	0.151	0.151	0.151	0.160
Inline sensor	10 cc	0.579	0.579	—	—
	5 cc	0.281	0.281	0.281	0.291
	3 cc	0.160	0.160	0.160	0.170

Baxter catheters

Injectate temperature 22.5 to 27°C

		8F	7.5F	7F	6F	5.5F
Bath probe	10 cc	0.612	0.594	0.595	0.607	0.616
	5 cc	0.301	0.283	0.287	0.304	0.304
	3 cc	0.177	0.159	0.165	0.180	0.180
Inline sensor	10 cc	0.601	0.599	0.616	0.616	0.624
	5 cc	0.294	0.301	0.311	0.307	0.310
	3 cc	—	—	—	—	—

Injectate temperature 18 to 22.5°C

		8F	7.5F	7F	6F	5.5F
Bath probe	10 cc	0.588	0.582	0.578	0.597	0.606
	5 cc	0.283	0.277	0.274	0.297	0.298
	3 cc	0.158	0.156	0.154	0.174	0.175
Inline sensor	10 cc	0.593	0.593	0.603	0.602	0.612
	5 cc	0.288	0.297	0.295	0.298	0.304
	3 cc	—	—	—	—	—

Injectate temperature 5 to 18°C

		8F	7.5F	7F	6F	5.5F
Bath probe	10 cc	0.563	0.575	0.562	0.573	0.581
	5 cc	0.267	0.267	0.262	0.278	0.281
	3 cc	0.148	0.150	0.144	0.159	0.161
Inline sensor	10 cc	0.578	0.578	0.570	0.568	0.581
	5 cc	0.272	0.286	0.257	0.276	0.288
	3 cc	—	—	—	—	—

Injectate temperature 0 to 5°C

		8F	7.5F	7F	6F	5.5F
Bath probe	10 cc	0.564	0.564	0.542	0.547	0.555
	5 cc	0.262	0.257	0.247	0.259	0.264
	3 cc	0.139	0.143	0.132	0.144	0.148
Inline sensor	10 cc	0.562	0.563	0.537	0.533	0.549
	5 cc	0.267	0.276	0.217	0.253	0.272
	3 cc	—	—	—	—	—

Changing the Height and Weight

The height and weight data displayed on the CHECK RESULT window are the values entered for the patient information on the PATIENT INFO window. Because this data is used as BSA in the calculation of hemodynamics after CO measurement, check that it is correct before performing CO measurement. The height and weight can be changed on the CO window.

When these values are changed, the settings on the PATIENT INFO also change.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “CO” key. The CO window appears.

3. Touch the “PATIENT SETTING” tab to display the PATIENT SETTING window.

4. Change the height and weight.

   1) Touch the data box.

   2) Enter the value with the numeric keys.

   3) Touch the “SET” key to register the setting.

Measuring the Pulmonary Capillary Pressure

Inserting and Retaining the Catheter in the Patient

For details and precautions on the methods of inserting the catheter, refer to relevant literature and manuals.

Inserting Position and Inserting Method

- Inserting position
  Elbow veins, basilic veins, external jugular veins, subclavian veins, femoral veins, and saphenous veins.
  Generally the upper limb arteries are used.

- Inserting method
  Arterial incision and Seldinger method.

Inserting the Catheter into the Patient and Monitoring Blood Pressure

CAUTION

- **Insert or extract the catheter from the pulmonary artery as quickly as possible. If it takes a long time (about longer than 10 seconds), pulmonary infarction, pulmonary hemorrhage or pulmonary artery perforation may occur.**
- **Insert or extract the catheter by referring to the blood pressure waveform on the monitor, X-ray unit images, and other equipment. Do not depend on the insertion or extraction messages displayed on the monitor.**

NOTE

- **Set the label to PAP to monitor the blood pressure for checking the catheter position.**
- **When inserting the catheter into the patient, monitor the blood pressure waveform and check the position of the catheter at all times.**

1. Insert the catheter to the right atrium quickly and inflate the balloon.

2. While checking the position of the catheter from the pressure waveform on the monitoring screen, push it slowly to the pulmonary artery in the direction of the blood flow.

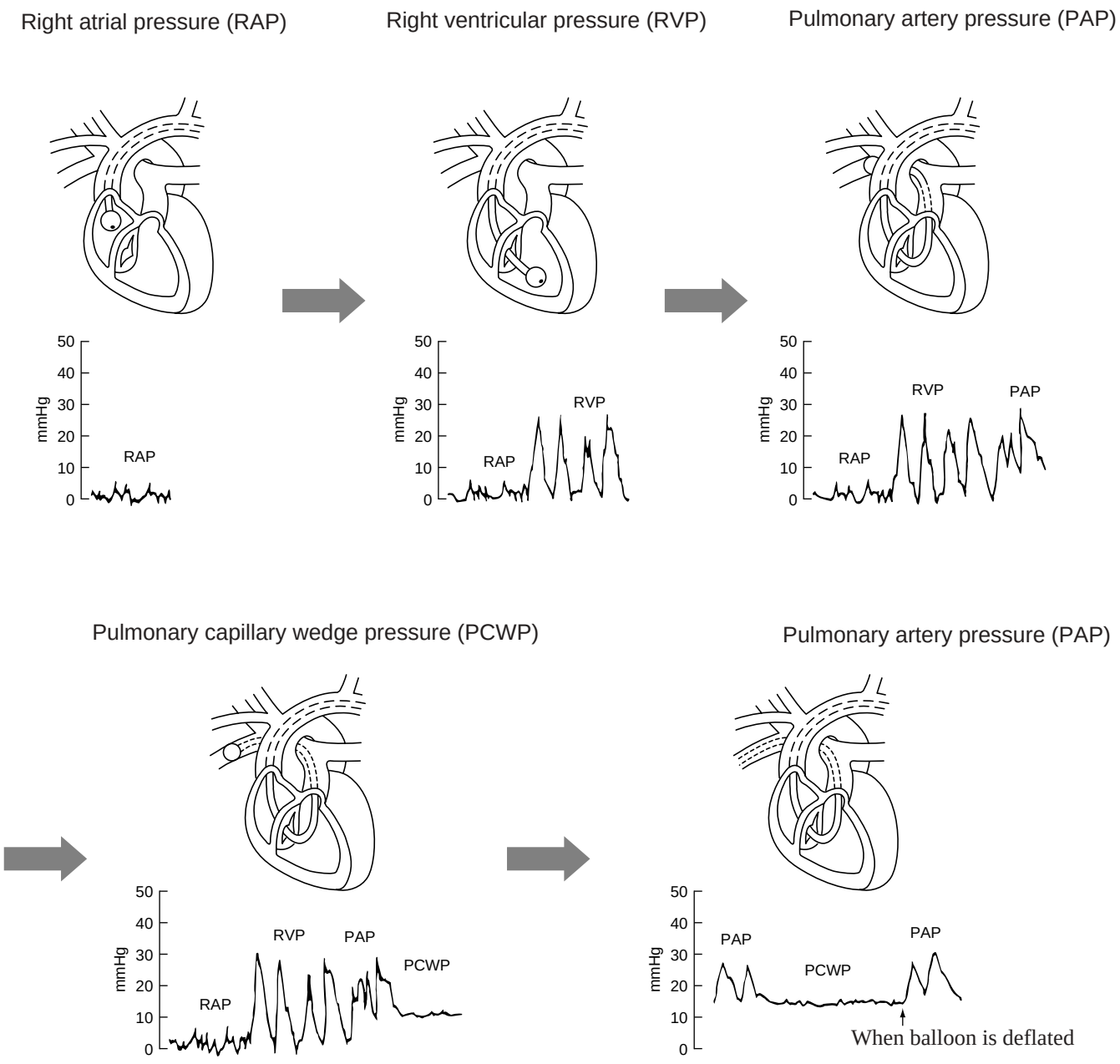
3. After inserting the catheter to the position where the pulmonary capillary wedge pressure (PCWP) waveform can be obtained, deflate the balloon promptly, and check that the pulmonary artery pressure (PAP) waveform is obtained.

4. After determining the position at which the PCWP waveform is obtained when the balloon is inflated and the PAP waveform is obtained when deflated, retain the catheter in the pulmonary artery.

NOTE

Monitor the pulmonary artery pressure (PAP) waveform while retaining the catheter and check at all times that the tip of the catheter is at the main branches of the pulmonary artery and not wedging into a peripheral artery.

Changes in Blood Pressure Waveform When Inserting Catheter (Example)



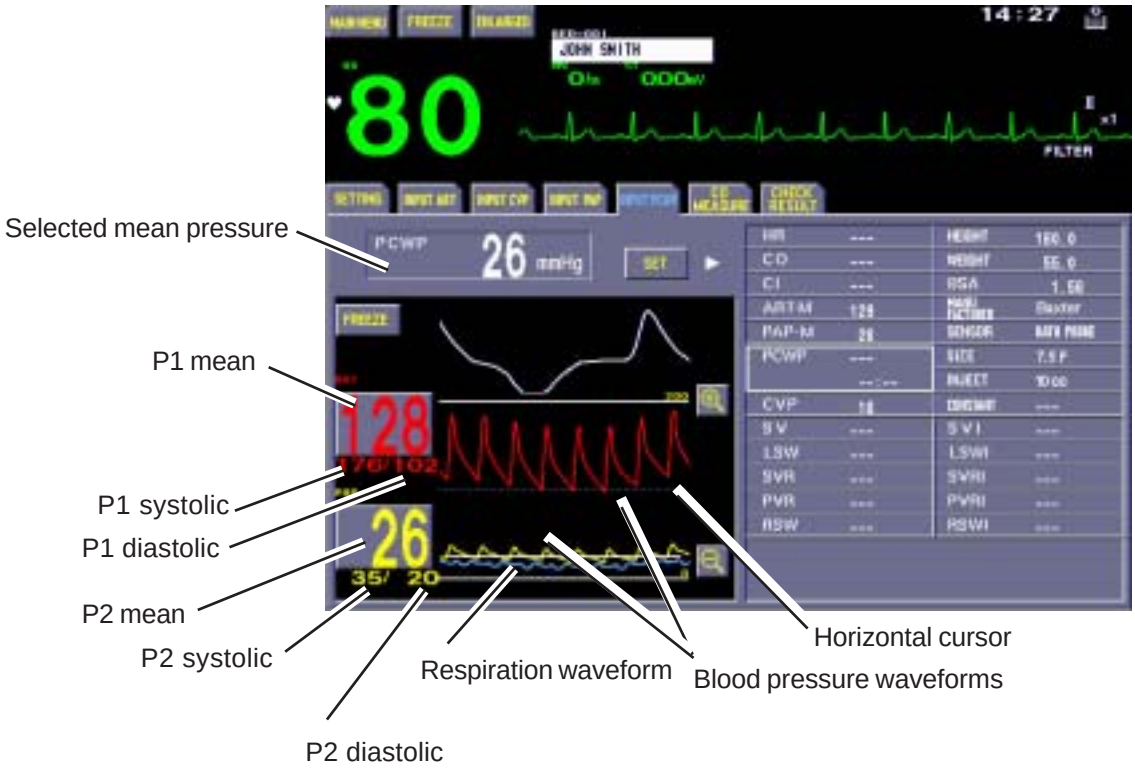
Entering the PCWP and Other IBP Values

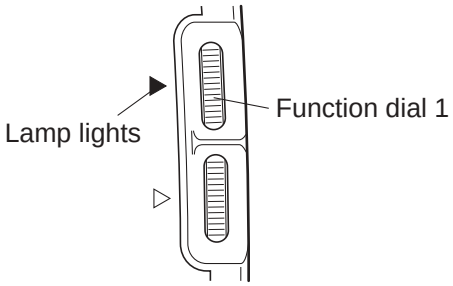
Enter the IBP values required for calculating the CO.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “CO” key. The CO window appears.

3. Touch “INPUT ART” to enter ART mean value, “INPUT CVP” to enter CVP mean value, “INPUT PAP” to enter PAP value and “INPUT PCWP” to enter PCWP. The INPUT window appears.





4. Touch either the “Mean P1” or “Mean P2” key to enter the mean value. The mean value appears in the selected mean pressure box.

   If necessary, you can change the appropriate mean value by moving the horizontal cursor. The cursor can be moved by dragging it with your finger or touchpen, or by turning the function dial 1 on the front panel.

   By touching the key and key, you can change the scale of the pressure waveforms.

5. Touch the “SET” key. The value is entered into the list.

Measuring CO

Before Measurement

Perform the following before measurement.

1. Completely fill the blood pressure transducer, dome and tubes with physiological saline with heparin to eliminate air completely.

2. Inject physiological saline with heparin in the CVP lumen of the catheter using a syringe and check that liquid flows out from the tip of the CVP lumen.

3. Fill the PA lumen with physiological saline with heparin.

Check the following before measurement.

1. Check the injectate temperature.

NOTE

If the temperature is not appropriate, the "Ti TEMP ERROR" message is displayed on the screen, Ti is fixed at 27°C and the CO value cannot be measured.

2. Check that the injectate temperature measurement lines (thermistor probe and in-line sensor) are connected correctly.

NOTE

If these are not connected correctly, the monitor assumes the injectate temperature to be 0°C (32°F).

3. Check the settings on the SETTING window.

NOTE

The settings, such as injectate volume and catheter size are necessary for calculating CO. These settings cannot be changed after measurement.

Measuring CO

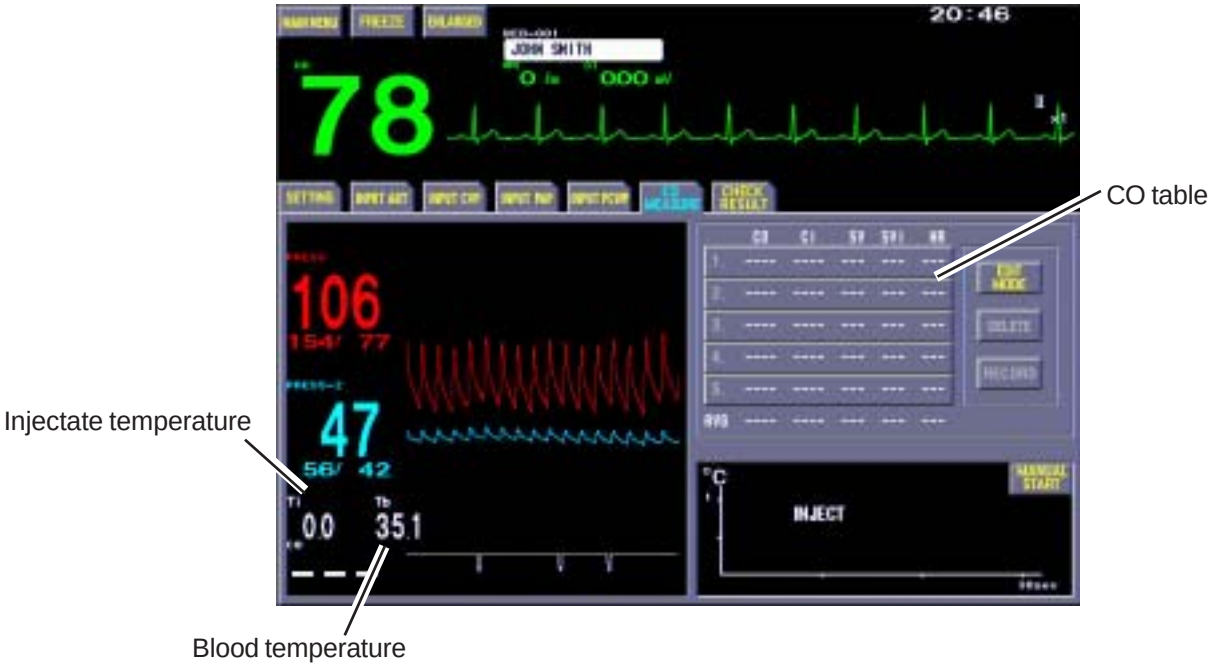
CAUTION

Do not measure the cardiac output repeatedly at short intervals. Frequently injecting the injectate affects the measuring accuracy.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "CO" key. The CO window appears.

3. Touch the “CO MEASURE” tab to display the CO MEASURE window.



4. Check that the “INJECT” message is displayed on the CO MEASURE window, inject the injectate quickly within 4 minutes and start CO measurement.

NOTE

- **If the injectate is not injected within 4 minutes, the “INJECTION TIME OUT” message appears. In this case, touch the “MANUAL START” key on the CO MEASURE window, and inject the injectate within 30 seconds.**
- **Inject the injectate as quickly and steadily as possible. Measurement cannot be performed correctly if injected slowly.**

5. Check that the “MEASURING CO” message is displayed on the CO MEASURE window.

NOTE

The monitor has not acknowledged the injection if the “MEASURING CO” message is not displayed on the CO MEASURE window after the injectate has been injected. If this occurs, inject the injectate again.

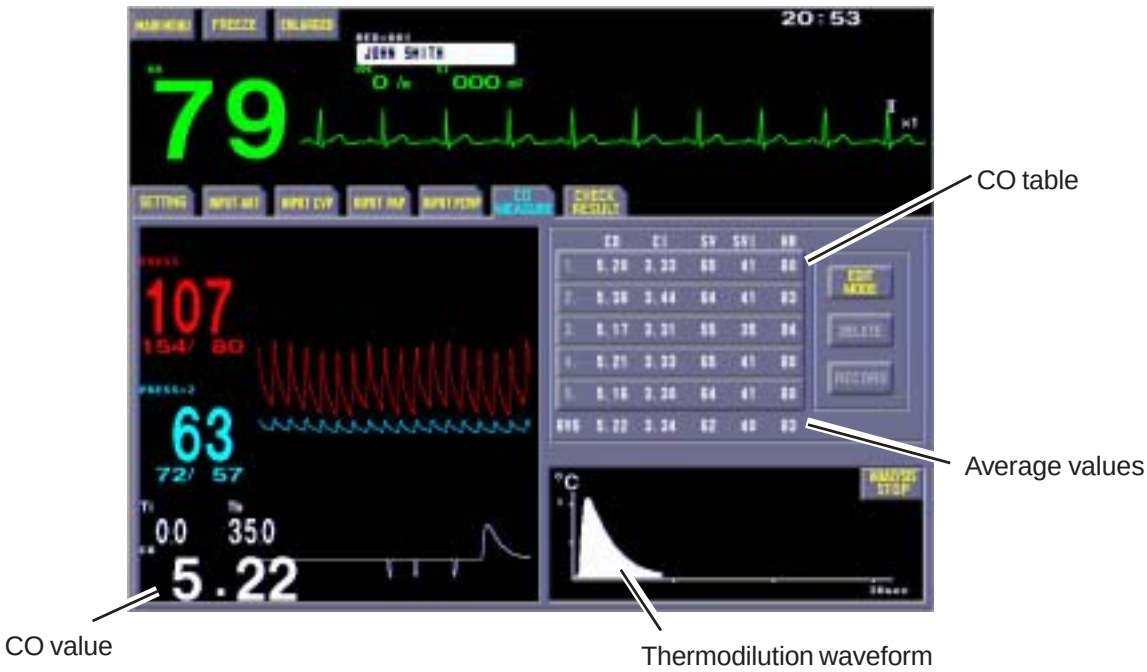
When the CO value is calculated, the measurement results are displayed in the CO table.

When the “INJECT ” message is displayed on the CO MEASURE window again, the injectate can be injected again.

To cancel measuring CO, touch the “ANALYSIS STOP” key.

Up to five measurement data can be stored in memory and displayed in the CO table. If more than five measurements are performed, the oldest data is deleted.

To add the measurement data on the CO MEASURE window to the hemodynamics list on the HEMO LIST window, refer to the “Adding the Acquired Data to the HEMO LIST Window” section. The HEMO LIST window is only available on the BSM-4103/4104/4113/4114 monitors.



Explanation of Hemodynamics Data

Label	Name	Unit	Explanation and Equation
HR	Heart rate	min^{-1}	Heart rate at the time the CO is measured.
CO	Cardiac output	$L \cdot min^{-1}$	—
CI	Cardiac index	$L \cdot min^{-1} \cdot m^{-2}$	CI=CO/BSA
ASP	Arterial systolic pressure	mmHg	Values registered at the time the CO is measured.
ADP	Arterial diastolic pressure		
AMP	Arterial mean pressure		
PASP	Pulmonary arterial systolic pressure		
PADP	Pulmonary arterial diastolic pressure		
PAMP	Pulmonary arterial mean pressure		
PCWP	Pulmonary capillary wedge pressure		
CVP	Central venous pressure mean		
SV	Stroke volume	mL	SV = (CO × 1000)/HR
LSW*	Left ventricular stroke work	g· m	LSW = {SV × (AMP – PCWP)} × 0.0136
SVR	Systemic vascular resistance	$dyn \cdot s \cdot cm^{-5}$	SVR = {(AMP – CVP) × 80)}/CO
PVR*	Pulmonary vascular resistance		PVR = {(PAMP – PCWP) × 80}/CO
RSW	Right ventricular stroke work	g· m	RSW = {13.6 × CO × (PAMP – CVP)}/HR
SVI	Stroke volume index	$mL \cdot m^{-2}$	SVI = (CI × 1000)/HR
LSWI*	Left ventricular stroke work index	$g \cdot m \cdot m^{-2}$	LSWI = {SVI × (AMP – PCWP)} × 0.0136
SVRI	Systemic vascular resistance index	$dyn \cdot s \cdot cm^{-5} \cdot m^{-2}$	SVRI = {(AMP – CVP) × 80}/CI
PVRI	Pulmonary vascular resistance index		PVRI = {(PAMP – PCWP) × 80}/CI
RSWI	Right ventricular stroke work index	$g \cdot m \cdot m^{-2}$	RSWI = {13.6 × CO × (PAMP – CVP)}/(HR × BSA)

* When PCWP is not measured, "- - -" appears.

When Measurements Cannot be Performed Correctly

In some cases, measurements cannot be performed correctly because the baseline moves due to noise or conditions of the patient, such as physiological changes. In such cases, touch "MANUAL START" on the CO MEASURE window and inject the injectate within 30 seconds. The point when the "MANUAL START" is touched is the start of measurement.

NOTE

If the injectate is not injected within 30 seconds, the "INJECTION TIME OUT" message appears.

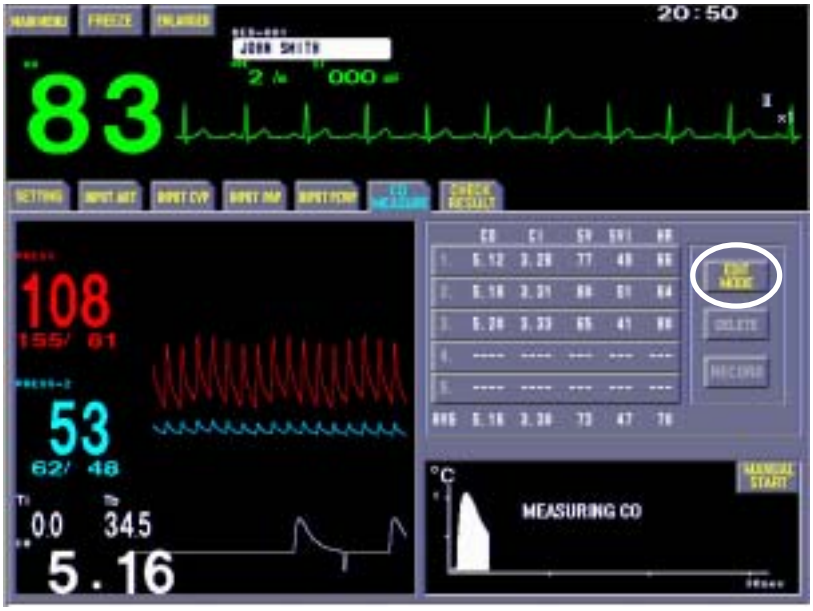
Deleting the Data from the CO Table

Up to five measurement data can be stored and displayed in the CO table on the CO window. The stored data can be deleted from the list.

NOTE

Once data is deleted, it cannot be recovered.

1. On the CO MEASURE window, touch the “EDIT MODE” key.



2. Select the data to be deleted.

3. Touch the “DELETE” key. The selected data is deleted and the average values are recalculated.

Recording Data on the CO MEASURE Window

Up to 5 hemodynamics data and a thermodilution curve displayed on the CO MEASURE window can be recorded. Recording is only available on the BSM-4101/4102/4103/4104 monitors.

1. On the CO MEASURE window, touch the “EDIT MODE” key.

2. Touch the “RECORD” key. The data displayed on the CO MEASURE window is recorded.

Adding the Acquired Data to the HEMO LIST Window

The acquired data can be added to the hemodynamics list in the HEMO LIST window. When data is added to the Hemodynamics List window, the data disappears from the monitoring screen and the CO table on the CO MEASURE window. “- - -” appears on the CO data display area on the monitoring screen.

The HEMO LIST window is only available on the BSM-4103/4104/4113/4114 monitors.

Check the data on the CO MEASURE window before adding.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “CO” key. The CO window appears.

3. Touch the “CHECK RESULT” tab to display the CHECK RESULT window.

4. Touch the “YES” key below the “ADD TO HEMODYNAMICS LIST?” message to add the data to the hemodynamics list in the HEMO LIST window.

   To display the HEMO LIST window, touch the “DISPLAY HEMODYNAMICS LIST” key.

CO Value Calculation Equation/Coefficient Value Calculation Value

In this monitor, the CO value is calculated using the following equation.

$$CO = \frac{(1.08)Ct(60)V(Tb - Ti)}{1000\int_0^\infty \Delta Tbdt}$$

$$1.08 = \frac{\rho Cp \text{ in the injectate}}{\rho Cp \text{ in the blood}}$$

ρ : density
Cp: specific heat

Ct = Compensated coefficient (determined by the catheter manufacturer, size, V and Ti)
60 = seconds in a minute
V = Injectate volume (mL)
Tb = Blood temperature (℃)
Ti = Injectate temperature (℃)
$\int_0^\infty \Delta Tbdt$ = Integrated value of the thermodilution curve

In this equation

$$\frac{(1.08)Ct(60)V}{1000} = \text{Coefficient value}$$

Section 18 CO_2 Monitoring

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General

CO_2 monitoring by the mainstream method is performed by connecting the TG-900P or TG-950P CO_2 sensor kit to the patient's respiration circuit and to the multi-parameter socket on the monitor. When monitoring with the TG-950P CO_2 sensor kit, $FiCO_2$ is also monitored.

WARNING

When performing defibrillation during CO_2 monitoring with the CO_2 sensor kit, remove the sensor from the patient. When the sensor cannot be removed, do not touch the sensor cable because the discharged energy may cause serious electrical burn, shock or other injury.

NOTE

CO_2 monitoring using the multi-parameter socket does not comply with the Defibrillator proof type BF.

Mainstream Method

In the mainstream method, the sensor is located directly in the respiration circuit. There are two sensors for different calculation methods.

Semi quantitative method using the TG-900P CO_2 sensor kit
Measurements are based on the assumption of no CO_2 gas in the inspiration. The CO_2 concentration in the respiration is calculated by taking the CO_2 concentration in the inspiration as 0 mmHg.

Quantitative method using the TG-950P CO_2 sensor kit
The CO_2 partial pressure in both inspiration and expiration is measured.

The mainstream CO_2 measurement method has the following merits and limits compared to the sidestream method. Understand these points when performing measurements.

Merits
- No delay in the measurement time.
- Measurement is stable over a long period of time.
- No measurement error due to mixture of water droplets.

Limits
- Cannot be used on non-intubated patients.
- Due to the weight of the CO_2 sensor, load is easily imposed on the tracheal tube.
- The dead space volume is relatively large.

WARNING

- **Do not use the airway adapter on neonates because the dead space volume of the airway adapter is about 5 cc.**
- **When using the airway adapter on children or patients with low ventilatory amount, the CO_2 may mix in the inspiration due to the airway adapter's dead space volume (5 cc), resulting in inaccurate measured values or difficulty in detecting apnea.**
- **Before MRI examination, remove the CO_2 sensor kit from the patient. Failure to follow this warning may cause serious electrical burn on the patient due to local heating caused by dielectric electromotive force. For details, refer to the MRI operator's manual.**
- **With the TG-900P CO_2 sensor kit, this monitor cannot monitor CO_2 of patients younger than 3 years old or weighing less than 10 kg (22 lbs).**

CAUTION

- **When monitoring CO_2 of a patient under anesthesia, make sure that the gas composition is entered. Otherwise the measurement result may be inaccurate.**
- **When using an anesthetic instrument with volatile anesthetic agent, the CO_2 measurement may become inaccurate.**
- **With the TG-900P CO_2 sensor kit, measurements are based on the assumption of no CO_2 gas in the inspiration. The CO_2 concentration in the respiration is calculated by taking the CO_2 concentration in the inspiration as 0 mmHg. Therefore, measuring CO_2 by connecting the CO_2 sensor kit to a Jackson Rees circuit or Mapleson D circuit where CO_2 gas may be present during inspiration may result in the acquired data being lower than the actual value.**
- **With the TG-950P CO_2 sensor kit, measured value may be incorrect when the operating temperature changes greatly. In this case, wait for about 30 minutes to acquire stable measurement.**

NOTE

The measurement may be inaccurate when the monitor is used in the following conditions. Read the measured values carefully.

1. **When used for patients with an extremely high respiration rate or patients with irregular respiration.**
2. **When used for children or patients with low ventilatory amount. In some cases, the CO_2 mixes in the inspiration due to the airway adapter's dead space volume (5 cc), resulting in inaccurate measured values or difficulty in detecting apnea.**
3. **When there is high concentration nitrous oxide gas in the airway adapter.**
4. **When used in environments with sudden temperature changes.**
5. **When used in environments with severe humidity.**

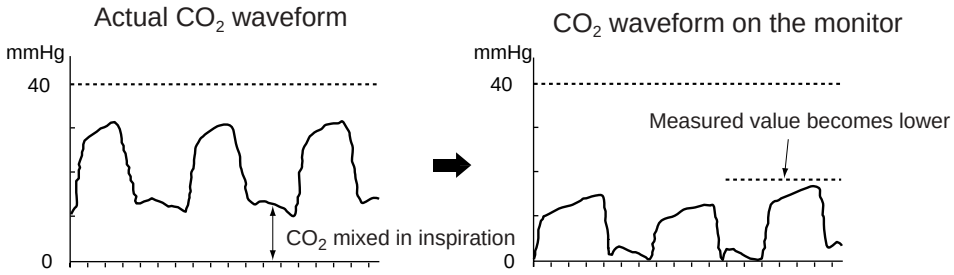
With TG-900P CO_2 sensor kit only

1. **When used in places with low atmospheric pressure such as at high altitude.**
2. **When used for patients with irregular spontaneous respiration.**

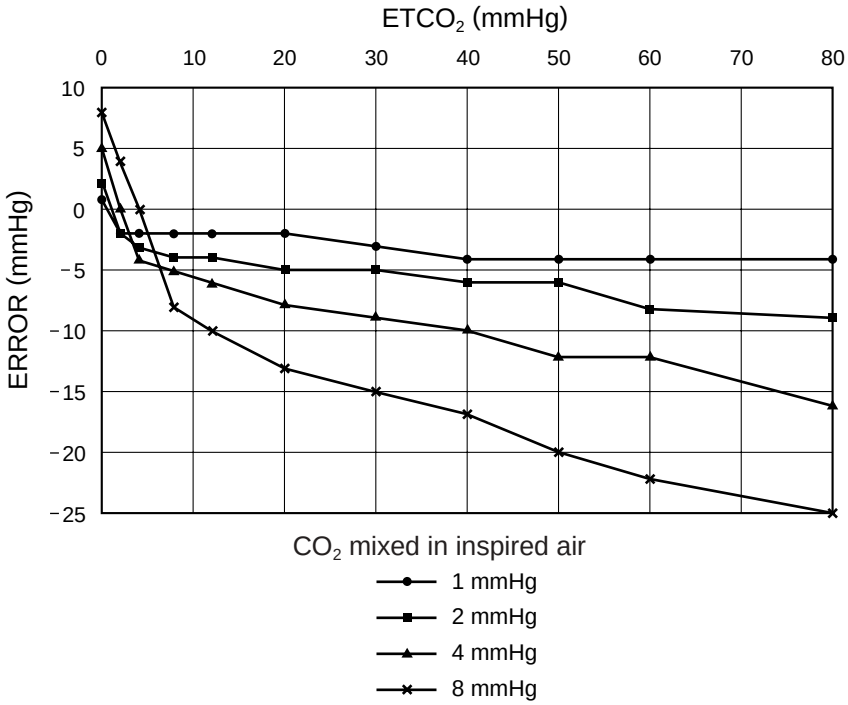
Measurement Error with the TG-900P CO_2 Sensor Kit

With the TG-900P CO_2 sensor kit, measurements are based on the assumption that the inspiration contains no CO_2 gas. Consequently, when CO_2 gas mixes in the inspiration, measured values will be lower than normal.

When CO_2 is mixed in inspiration



Measurement Error when CO_2 is Mixed in the Inspired Air



CO_2 Sensor Kit and Airway Adapter

CAUTION

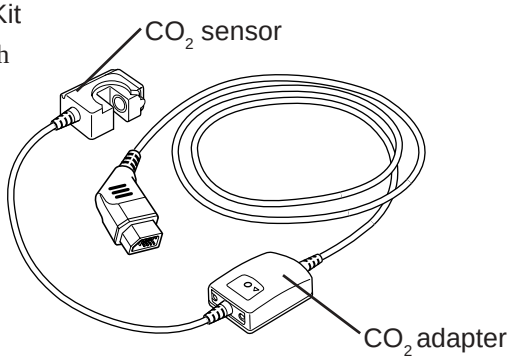
- **The airway adapter is non-sterilized and disposable. Use only for single patient and single use. Failure to follow this instruction causes cross infection.**
- **Do not sterilize the airway adapter more than once. The safety cannot be guaranteed.**
- **Use the Nihon Kohden specified airway adapter.**
- **The transparent film of the airway adapter is coated with the anti-fogging material to prevent the moisture of the expiration and inspiration from making the inside of the airway adapter foggy. Under the operating environment specified in the specifications, the anti-fogging material works for about 24 hours. For the optimum performance of the anti-fogging material and correct measurement, follow the instructions below.**
  - **Do not use the airway adapter more than 24 hours.**
  - **Replace the airway adapter if blood, sputum or mucus adheres to the transparent film of the airway adapter.**
  - **Do not damage the transparent film, and do not let dust or chemical solutions contact the transparent film. Do not touch the transparent film with your fingers, do not wipe it, and do not wash it with alcohol or other detergents.**

For semi quantitative method

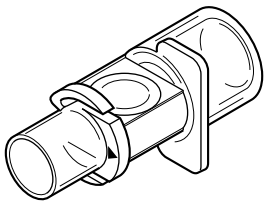
WARNING

- **Do not use the airway adapter on neonates because the dead space volume of the airway adapter is about 5 cc.**
- **When using the airway adapter on children or patients with low ventilatory amount, the CO_2 may mix in the inspiration due to the airway adapter's dead space volume (5 cc), resulting in inaccurate measured values or difficulty in detecting apnea.**

TG-900P CO_2 Sensor Kit
TG-101T CO_2 sensor with
JG-900P CO_2 adapter



YG-101T Airway Adapter



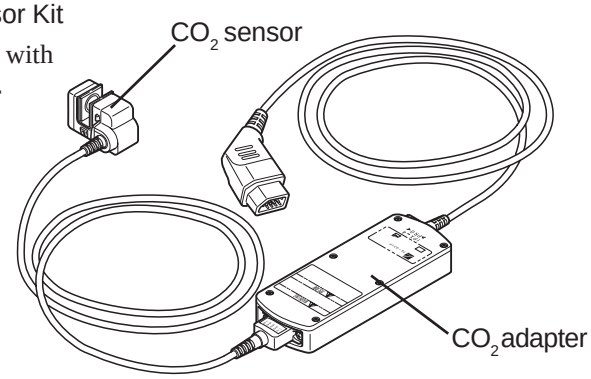
Model	Patient	Weight	Dead space volume	Code No.
YG-101T	Adult	10 kg or more	5 cc	R801

For quantitative method

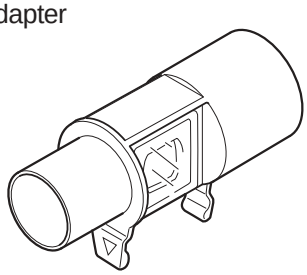
CAUTION

- **Select the airway adapter taking the patient ventilation volume into consideration. If an inappropriate airway adapter is used, the resistance in the respiration circuit increases or the measurement value is incorrect.**
- **When using the airway adapter on children or patients with low ventilatory amount, perform ventilation taking the airway adapter's dead space volume into consideration.**

TG-950P CO_2 Sensor Kit
TG-201T CO_2 sensor with
JG-950P CO_2 adapter



YG-201T/202T Airway Adapter



Model	Patient	Weight	Dead space volume	Code No.
YG-201T	Adult	10 kg or more	5 cc	R802
YG-202T	Pediatric	3 to 10 kg	2 cc	R803

Preparing for CO_2 Monitoring

Preparation Flowchart

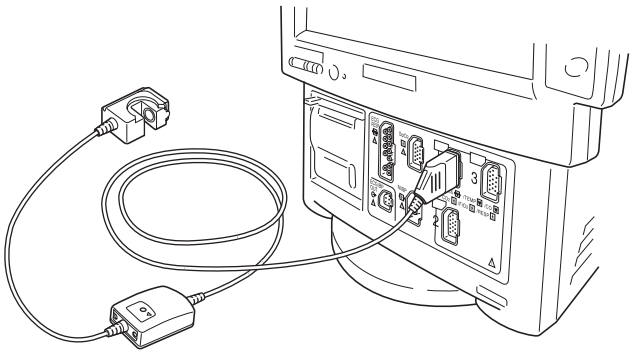
1. Select the CO_2 sensor kit and airway adapter.
2. Connect the CO_2 sensor kit to the multi-parameter socket on the monitor.
3. Connect the CO_2 sensor to the respiration circuit.
4. Start measurement and change necessary settings.

   For handling accessories after use, refer to Section 21.

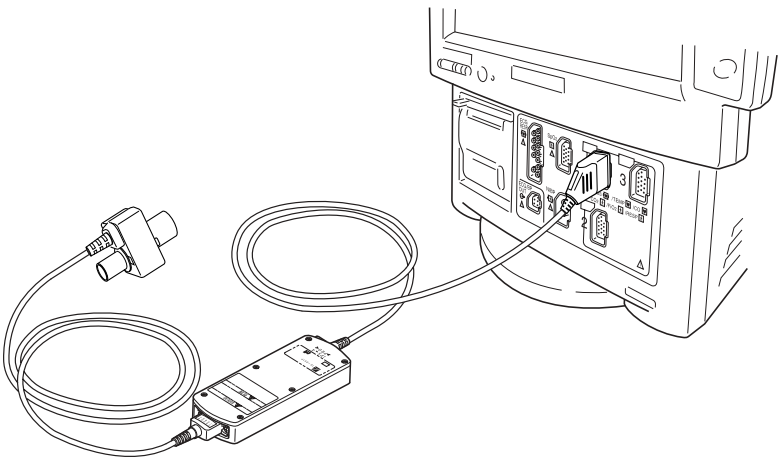
Connecting the CO_2 Sensor Kit to the Monitor

Connect the CO_2 sensor kit to the multi-parameter socket on the monitor. Only one multi-parameter socket can be used for monitoring CO_2.

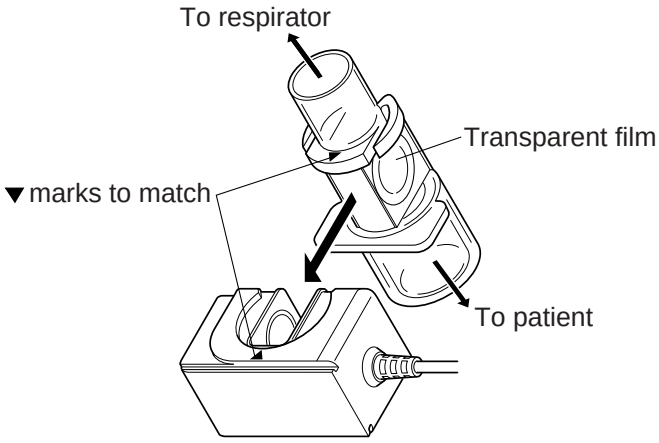
<When using TG-900P CO_2 sensor kit>



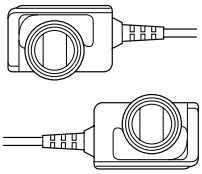
<When using TG-950P CO_2 sensor kit>



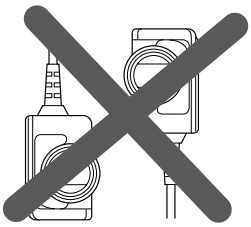
Connecting the CO_2 Adapter to the Respiration Circuit



OK



The cable is parallel and the transparent film is perpendicular to the floor.



The cable is perpendicular and the transparent film is parallel to the floor.

Using TG-900P CO_2 Sensor Kit

1. Connect the airway adapter to the CO_2 sensor so that the ▼ marks on the airway adapter and CO_2 sensor align.

NOTE

- **When connecting the airway adapter to the CO_2 sensor, do not touch the transparent film of the airway adapter with your fingers or any hard object, and do not allow dust or chemical solutions to adhere to it. Otherwise measurement may not be accurate.**
- **The airway adapter is not sterilized.**

2. Connect the airway adapter to the respiration circuit of the respirator.

   Connect the larger end of the airway adapter to the mask or trachea tube of the patient, and the smaller end to the resuscitation bag or respirator.

3. Attach the CO_2 sensor to a support arm so that the weight of the CO_2 sensor does not affect the patient. Secure it properly.

CAUTION

Secure the CO_2 sensor cable to the respiration circuit so that it is parallel to the floor. If the cable is perpendicular to the floor, water droplets may get onto the transparent film of the airway adapter, and affect the measurement accuracy.

Using TG-950P CO_2 Sensor Kit

1. Select either the YG-201T or YG-202T airway adapter, whichever is suitable for the patient weight and ventilation volume.

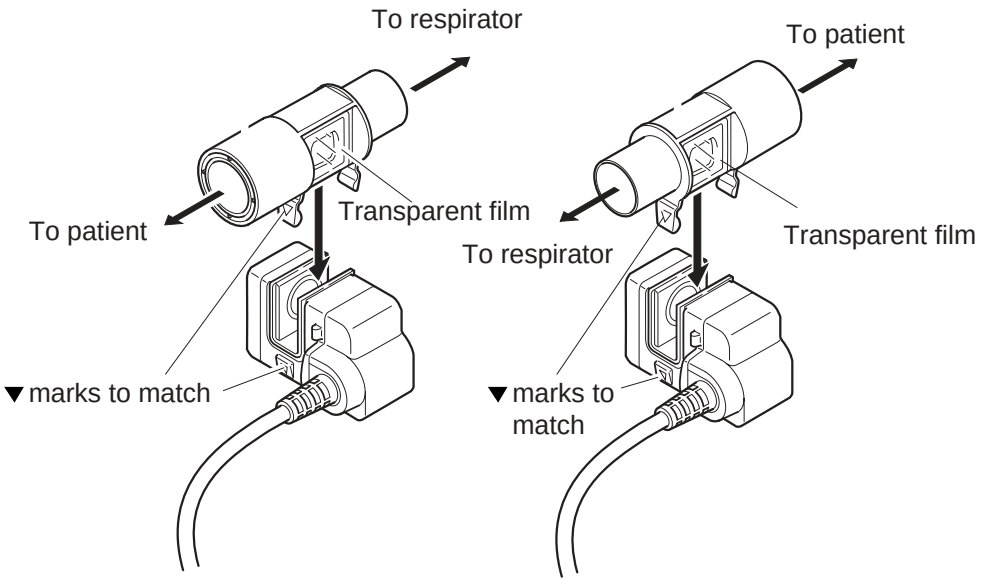
2. Connect the airway adapter to the CO_2 sensor so that the ▼ marks on the airway adapter and CO_2 sensor align.

NOTE

- **When connecting the airway adapter to the CO_2 sensor, do not touch the transparent film of the airway adapter with your fingers or any hard object, and do not allow dust or chemical solutions to adhere to it. Otherwise measurement may not be accurate.**
- **The airway adapter is not sterilized.**

3. Connect the airway adapter to the respiration circuit of the respirator.

   Connect the larger end of the airway adapter to the mask or trachea tube of the patient, and the smaller end to the resuscitation bag or respirator.



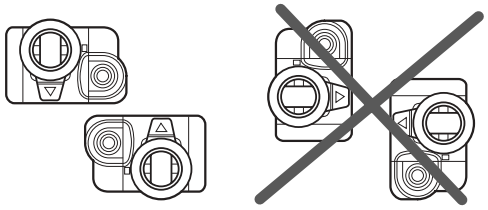
4. Check that there is no leak in the respiration circuit.

5. Attach the CO_2 sensor to a support arm so that the weight of the CO_2 sensor does not affect the patient. Secure it properly.

CAUTION

Secure the CO_2 sensor cable to the respiration circuit so that it is parallel to the floor. If the cable is perpendicular to the floor, water droplets may get onto the transparent film of the airway adapter, and affect the measurement accuracy.

OK



The cable is parallel and the transparent film is perpendicular to the floor.

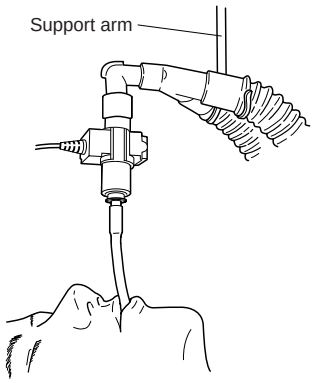
The cable is perpendicular and the transparent film is parallel to the floor.

Setup Examples

TG-900P CO_2 sensor kit is used in the examples.

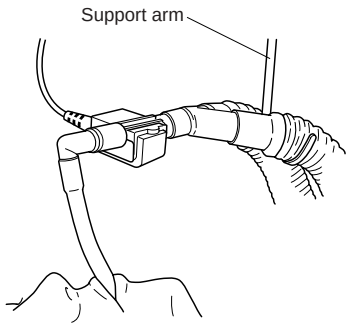
Setup example 1

Using a straight type trachea tube with a support arm during respiration



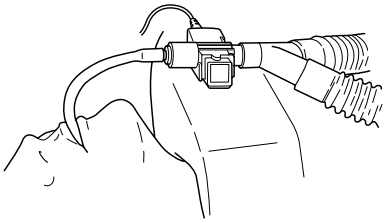
Setup example 2

Using an elbow type trachea tube with the CO_2 sensor support arm during respiration



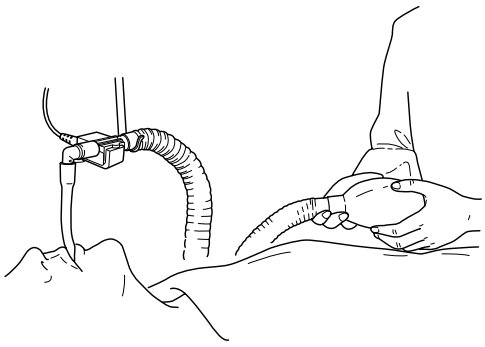
Setup example 3

With no support



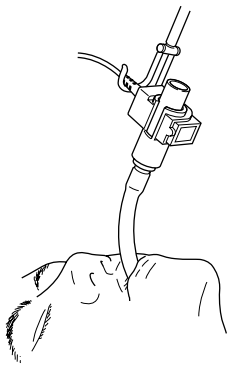
Setup example 4

Spontaneous respiration with a breathing bag



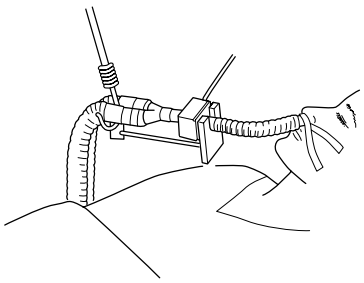
Setup example 5

Spontaneous respiration with no breathing bag



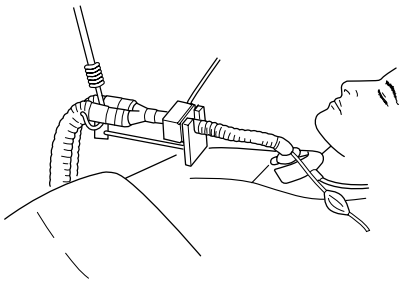
Setup example 6

Trans-nasal intubation

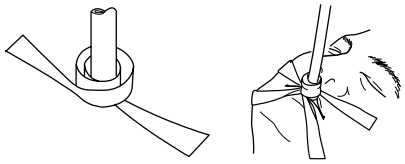


Setup example 7

Tracheal incision



Example of securing the tracheal tube



Performing Zero Calibration

When using the TG-950P CO_2 sensor kit, perform zero calibration in the following conditions.

- When the airway adapter is replaced with a new one.
- When a different type of airway adapter is used.
- When the operating temperature changes.
- When the measurement room is changed.
- Whenever necessary.

Zero calibration can be performed in two ways: calibration with air and calibration with N_2 gas. Both methods are performed on the CO_2 window.

- Calibration with air
  Expose the airway adapter to air. Calibrates with about 0.2 mmHg CO_2 in the air.
- Calibration with N_2 gas
  Flow N_2 gas into the airway adapter.

The calibrated value is saved in memory in the connector of the CO_2 sensor kit. Once calibrated, you don't need to calibrate again when connecting the CO_2 sensor kit to the socket of a different module.

Calibrating by Air

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "CO_2" key. The CO_2 window appears.

3. Touch the “AIR CAL” key in the SELECT CALIBRATION METHOD box. The TG-950P CO_2 sensor kit must be connected to the monitor for the SELECT CALIBRATION METHOD box to be displayed on the CO_2 window.

4. Expose the airway adapter to air and touch the “YES” key. The “CALIBRATING” message appears. When the “CALIBRATION COMPLETE” message is displayed, calibration is complete.

Calibrating with N_2 Gas

For handling the N_2 gas cylinder, refer to the N_2 gas manual.

1. Connect the airway adapter to the N_2 gas cylinder.

2. Press the MENU key on the front panel to display the MENU window.

3. Touch the "CO_2" key. The CO_2 window appears.

4. Touch the "N_2 CAL" key in the SELECT CALIBRATION METHOD box. The TG-950P CO_2 sensor kit must be connected to the monitor for the SELECT CALIBRATION METHOD box to be displayed on the CO_2 window.

5. Open the N_2 gas cylinder so that the N_2 gas flows into the airway adapter.

6. Touch the "YES" key to start calibration. The "CALIBRATING" message appears. When the "CALIBRATION COMPLETE" message is displayed, calibration is complete.

Monitoring CO_2

After completing the preparation, CO_2 data and waveform appear on the screen.

WARNING

When using an anesthetic instrument with volatile anesthetic agent, the CO_2 measurement may become inaccurate.

CAUTION

When the "CHANGE ADAPTER" or "CHANGE SENSOR" message is displayed, check the CO_2 sensor kit. CO_2 cannot be monitored while the message is displayed.

NOTE

When using TG-900P CO_2 sensor kit, this monitor performs calibration automatically every minute and when any of the following occurs.

- **Monitor power on**
- **Patient's first respiration**
- **Airway adapter is removed from the CO_2 sensor and connected again**
- **Respiration stopped for 20 seconds**
- **Signal changed rapidly due to temperature change**

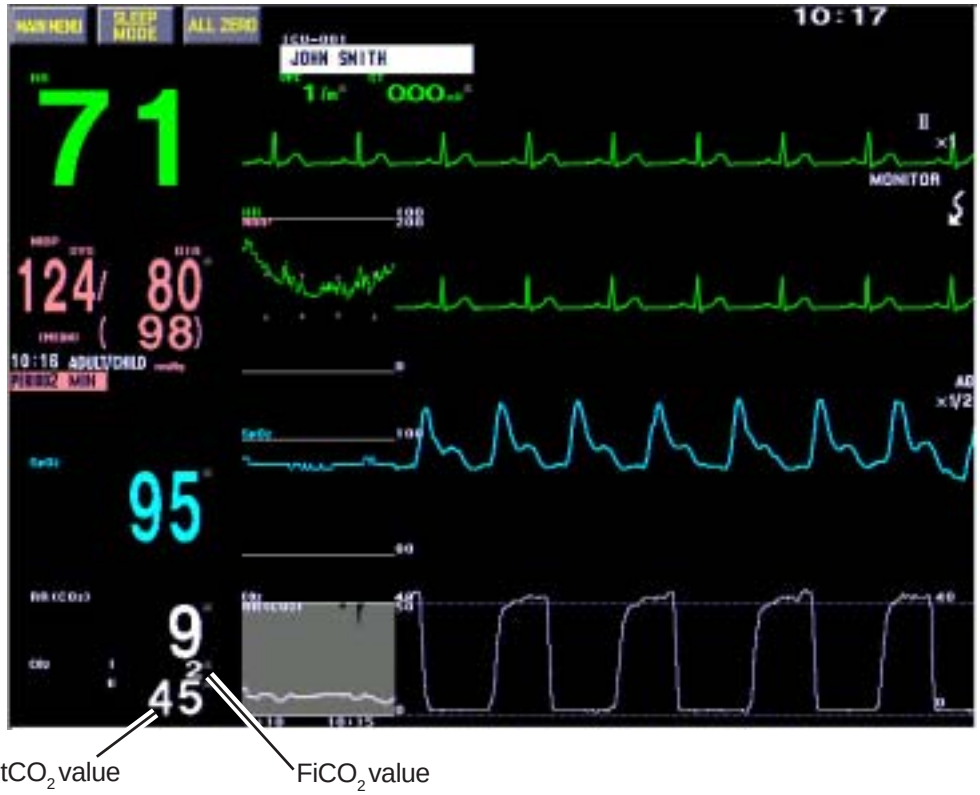
During calibration, the CO_2 waveform appears as the calibrated waveform, but the respiration rate and measured value are not affected.

For error messages and monitoring problems, refer to Section 20.

CO_2 Information on the Monitoring Screen

Monitoring with the TG-900P CO_2 sensor kit

Monitoring with the TG-950P CO_2 sensor kit



Changing CO_2 Settings

Change the settings on the CO_2 window. The following settings can be changed for CO_2 monitoring.

- Scale
- Respiration rate, apnea, $EtCO_2$ and $FiCO_2$ alarm settings
- Inspiration composition
- CO_2 waveform sweep speed

The CO_2 unit (mmHg or kPa) is the same as the pressure unit. The pressure unit is set on the SYSTEM SETUP screen. Refer to Section 3.

Changing the CO_2 Scale

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "CO_2" key. The CO_2 window appears.

3. Select the scale by touching the desired scale key in the SCALE box.

4. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Respiration Alarm Limits

CAUTION

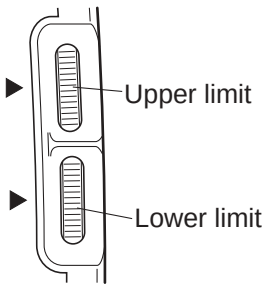
When the upper or lower alarm limit is turned off, there will be no respiration rate upper or lower alarm for that limit.

You can set the upper and lower respiration rate alarm limits on this window. Other alarm items must be set on the VITAL ALARM window. You can set all alarms, including the upper and lower respiration rate alarm limits, on the VITAL ALARM window (See Section 6).

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "CO_2" key. The CO_2 window appears.

3. Touch the respiration rate alarm setting bar.



4. Do one of the following:

   Use the function dials to change settings.

   Or,

1) Touch the upper limit box to set the upper limit or touch the lower limit box to set the lower limit.

2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

Or,

Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

If the upper limit is set to a value above the maximum or the lower limit is set to a value below the minimum, the alarm is set to OFF.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the Apnea Alarm Limit

CAUTION

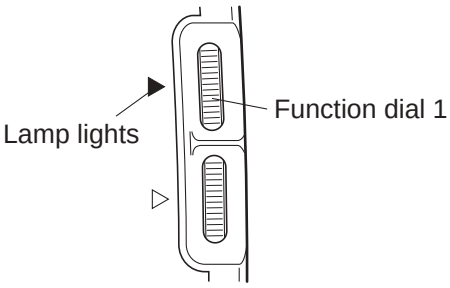
When the alarm limit is turned off, there will be no apnea alarm.

You can set the apnea alarm limit on the CO_2 window. You can set all alarms, including the apnea alarm limit, on the VITAL ALARM window (See Section 6).

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "CO_2" key. The CO_2 window appears.



3. Touch the apnea alarm setting bar.

4. Do one of the following:

   Use the function dial 1 to change the setting.

   Or,

   Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the $EtCO_2$ Alarm Limits

CAUTION

When the upper or lower alarm limit is turned off, there will be no $EtCO_2$ upper or lower alarm for that limit.

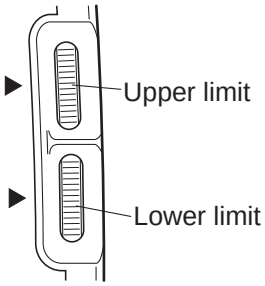
You can set the upper and lower $EtCO_2$ alarm limits on this window. Other alarm items must be set on the VITAL ALARM window. You can set all alarms, including the upper and lower $EtCO_2$ alarm limits, on the VITAL ALARM window (See Section 6).

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "CO_2" key. The CO_2 window appears.

3. Touch the $EtCO_2$ alarm setting bar.

4. Do one of the following:



Use the function dials to change settings.

Or,

1) Touch the upper limit box to set the upper limit or touch the lower limit box to set the lower limit.

2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

Or,

Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

If the upper limit is set to a value above the maximum or the lower limit is set to a value below the minimum, the alarm is set to OFF.

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the $FiCO_2$ Alarm Limit

CAUTION

When the upper alarm limit is turned off, there will be no $FiCO_2$ alarm for the upper limit.

You can set the upper $FiCO_2$ alarm limit on this window. Other alarm items must be set on the VITAL ALARM window. You can set all alarms, including the upper $FiCO_2$ alarm limit, on the VITAL ALARM window (See Section 6).

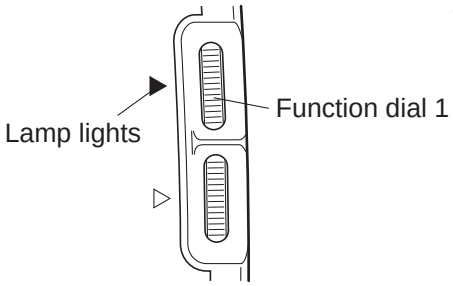
1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "CO_2" key. The CO_2 window appears.

3. Touch the "$FiCO_2$ ALARM" tab to display the $FiCO_2$ ALARM window.

4. Touch the $FiCO_2$ alarm setting bar to change the $FiCO_2$ alarm setting.

5. Do one of the following:



Use the function dial 1 to change settings.

Or,

1) Touch the upper limit box to set the upper limit.

2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

Or,

Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

If the upper limit is set to a value above the maximum, the alarm is set to OFF.

6. Press the HOME key on the front panel to return to the monitoring screen.

Setting the Inspiration Composition

When N_2O is mixed in the inspiration or when a high concentration of oxygen is inspired, sensitivity of CO_2 absorbing infrared ray is affected, and as a result measurements cannot be performed correctly. When using anesthetic gas or a respirator, set the inspiration composition. The monitor corrects the CO_2 concentration automatically according to the setting.

Use with Volatile Anesthetic Agent

CAUTION

When using an anesthetic instrument with volatile anesthetic agent, the CO_2 measurement may be inaccurate.

When using volatile anesthetic agent, the CO_2 value is off by the following amount (at 1 atmospheric pressure, 5% (38 mmHg) CO_2 and N_2 mixture gas, no condensation).

Anesthetic Gas	Concentration	Difference	
		TG-900P	TG-950P
Halothane	4%	+0.9 mmHg	+0.2 mmHg
Enflurane	5%	+1.5 mmHg	+0.4 mmHg
Isoflurane	5%	+1.8 mmHg	+0.8 mmHg
Sevoflurane	6%	+2.8 mmHg	+1.3 mmHg
Desflurane	24%	+7.0 mmHg	+3.2 mmHg

Procedure

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "CO_2" key. The CO_2 window appears.

3. Touch the “GAS” tab to display the GAS window.

4. Set the composition of the inspired gas.
   - When not using gas that influences measurement
     → Touch the “AIR” key.
   - When using respirator and anesthesia device
     → Touch the “O_2+AIR” key and set the O_2 ratio.

     To set the O_2 ratio:
     i) Touch the setting bar.
     ii) Use the function dial 1 to change settings.

     Or,

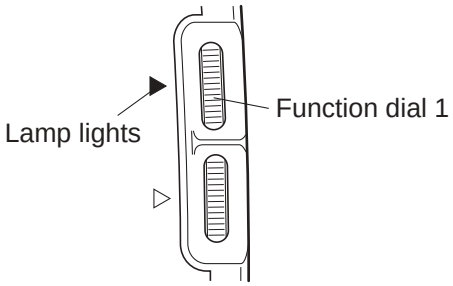
     ii) Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

   - When using anesthetic gas
     → Touch the “O_2+N_2O” key and set the gas ratio.

     To set the O_2 and N_2O ratio:
     i) Touch the setting bar.
     ii) Use the function dial 1 to change settings.

     Or,

     ii) Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.



5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the CO_2 Waveform Sweep Speed

The CO_2 waveform sweep speed on the screen can be selected from 1, 6, or 25 or 50 mm/s. This setting can also be changed on the DISPLAY window.

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "CO_2" key. The CO_2 window appears.

3. Touch the "OTHER SETTING" tab to display the OTHER SETTING window.

4. Select the CO_2 waveform sweep speed from the RESP/CO2 SWEEP SPEED box.

5. Press the HOME key on the front panel to return to the monitoring screen.

Inspection of Measuring Accuracy

Daily Inspection of Measuring Accuracy

Perform daily accuracy inspection using your own respiration.

Put the larger end of the airway adapter (side for connecting to the patient's mask and tracheal tube) into your mouth and after stabilizing breathing, breathe in the same way as in the resting state at a rate of 5 seconds per breath (12 breaths/minute). Breathing too quickly or taking deep breaths will disable standard measurements.

The standard $EtCO_2$ concentration is 40 mmHg. Check that the CO_2 gas concentration display is from 35 to 45 mmHg.

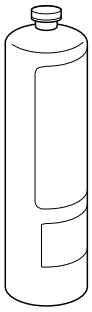
Inspection of Measuring Accuracy (Precise Method)

Check the measurement accuracy whenever you suspect the monitor is not reading correctly. This procedure does not calibrate CO_2 sensor. It only checks the measurement accuracy. If the measurement accuracy is not appropriate, contact your Nihon Kohden distributor.

The following parts are required.

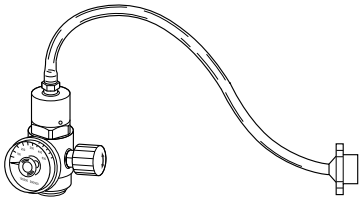
CAUTION

- **Only use the specified parts.**
- **Obey the CAUTION label on the CO_2 gas cylinder.**
- **After the lifetime of the CO_2 gas cylinder expires, the measurement accuracy cannot be guaranteed.**



- 5% CO_2 calibration gas

Manufacturer:	Nellcor Puritan Bennett or Scott Medical Products
Cylinder name:	OD (1 L disposable cylinder)
Outlet connection:	CGA 600
Gas volume:	25 L (Provides about 50 to 100 calibrations)
Gas component:	5% CO_2, 21% O_2, balance N_2
Accuracy:	±0.03% absolute
Expiration:	3 years after the gas is packed in the cylinder



- Flow regulator PR-150

Manufacturer:	VICTOR High Purity & Instrumentation
Delivery flow (flow rate):	0.5 L/min
Inlet connection:	CGA 600

- Tube

Internal diameter:	4 mm

- Slip joint
  Manufacturer: Portex
  Specification: 100/252 4 mm

When using a CO_2 gas cylinder and flow regulator other than the above, the following specifications must be met. Make sure that the outlet connection of the gas cylinder and the inlet connection of the flow regulator fit together.

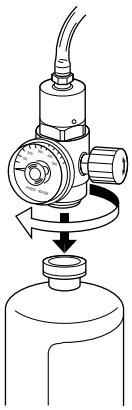
- 5% CO_2 calibration gas
  Gas component: 5% CO_2, 21% O_2, balance N_2
  Accuracy: ±0.03% absolute
- Flow regulator
  Delivery flow (flow rate): 0.5 L/min

Checking Procedure

NOTE

- **The monitor calculates the CO_2 concentration by assuming that the gas temperature is 37°C and the surrounding pressure is 1 atmospheric pressure. Therefore, if this checking procedure is performed at room temperature or lower, the monitor will display higher instCO_2 (there will be –0.4% per °C difference). Correspondingly, if the checking procedure is performed at high altitude, the monitor will display a lower instCO_2 reading (there will be 1 mmHg/30 hPa difference).**
- **When the pressure gauge of the flow regulator reads 0, replace the CO_2 gas cylinder with a new one.**

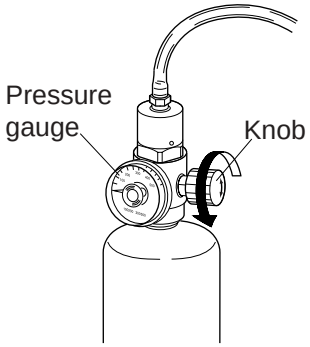
Using TG-900P CO_2 Sensor Kit



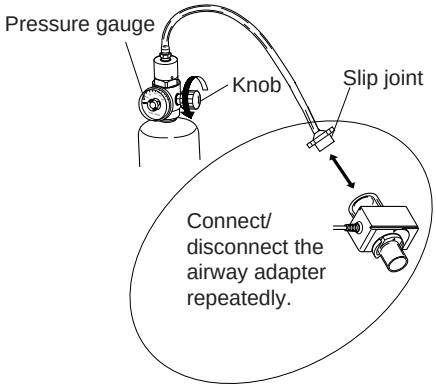
1. Connect the flow regulator to the CO_2 gas cylinder by rotating the flow regulator clockwise. Connect them firmly.

2. Connect the CO_2 sensor kit to the multi-parameter socket on the monitor.

3. Connect the airway adapter to the CO_2 sensor so that the ▼ marks on the airway adapter and CO_2 sensor align.



4. After checking that the CO_2 gas cylinder is connected properly, gently turn the knob of the flow regulator counterclockwise about half a turn to start the gas flow.



5. Connect the slip joint to the airway adapter. CO_2 gas flows in the airway adapter and the $ETCO_2$ on the screen should read 38 mmHg. (Expiration phase, 38 mmHg CO_2 gas)

6. Disconnect the slip joint from the airway adapter and shake the CO_2 sensor to remove CO_2 gas from the airway adapter. Open air flows into the airway adapter. Check that $ETCO_2$ is 0 mmHg from the CO_2 waveform on the screen. (Inspiration phase, no CO_2 gas)

CAUTION

This method assumes that no CO_2 gas is present in the inspiration phase of breathing. Therefore, step 6 has to be performed to simulate the inspiration phase of breathing so that the monitor can correctly determine the CO_2 concentration. The monitor determines the CO_2 concentration by comparing the change in CO_2 concentration in the airway adapter during the inspiration and expiration phase of breathing.

7. Repeat steps 5 and 6 a few times and compare the readings of step 5. The readings should be the same.

8. After checking, gently turn the flow regulator knob clockwise to stop the gas flow.

Using TG-950P CO_2 Sensor Kit

Do steps 1 to 5 and 8 of the procedure for the TG-900P CO_2 Sensor Kit.

Section 19 FiO_2 Monitoring

General 19.1
Preparing for FiO_2 Monitoring 19.2
- Preparation Flowchart 19.2
- Connecting the Oxygen Sensor to the Monitor 19.2
- Calibrating the O_2 Sensor 19.3
  - Calibration with Air (Simple method) 19.3
  - Calibration with 100% O_2 (Precise Method) 19.4
- Changing the FiO_2 Alarm Limits 19.5

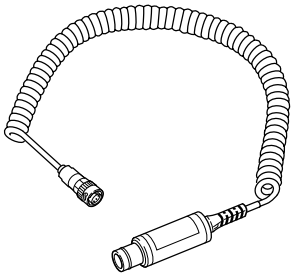
Connecting the Oxygen Sensor to the Inspiration Circuit and Starting Measurement 19.7
Principle and Structure of Oxygen Sensor 19.9
- Structure of Oxygen Sensor 19.9
- Life Span of Oxygen Sensor 19.9
- Precautions when Using the Oxygen Sensor 19.10

General

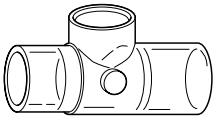
FiO_2 (inspired oxygen fractional concentration) monitoring is performed by attaching the oxygen sensor (074705) to the patient's inspiration circuit and connecting it to the multi-parameter socket on the monitor.

The inspired oxygen concentration of the patient is continuously measured.

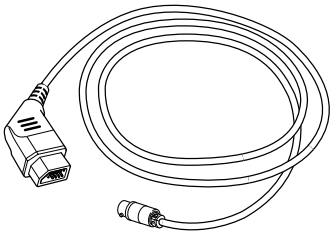
Oxygen sensor 074705*



T-shaped adapter 110774*



FiO_2 connection cord JO-900P



* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Preparing for FiO_2 Monitoring

Preparation Flowchart

1. Connect the oxygen sensor to the FiO_2 connection cord and FiO_2 connection cord to the multi-parameter socket on the monitor.
2. Calibrate the oxygen sensor.
3. Connect the oxygen sensor to the inspiration circuit of the patient.
4. Start measurement (Start monitoring).

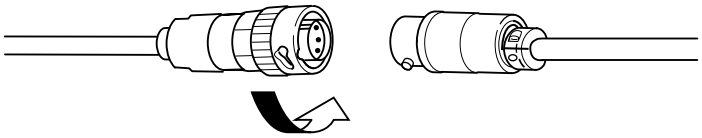
   For handling accessories after use, refer to Section 21.

Connecting the Oxygen Sensor to the Monitor

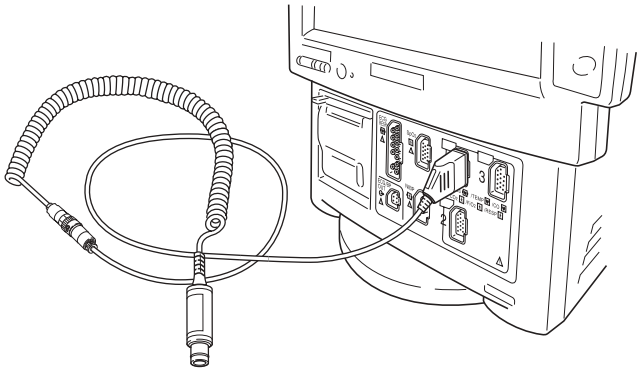
1. Connect the oxygen sensor to the FiO_2 connection cord.

NOTE

Rotate the ring until it clicks to lock it properly.



2. Connect the FiO_2 connection cord to the multi-parameter socket on the monitor.



Calibrating the O_2 Sensor

Perform calibration in the following cases.

- When starting measurements.
- When more than 24 hours have passed from the last calibration.
- When the oxygen sensor is disconnected from the FiO_2 connection cord and connected again.
- When the measured value seems to be incorrect.

CAUTION

The oxygen sensor must be stored with the detector facing down because the detector gets dried and FiO_2 monitoring cannot be performed properly. If the detector is dry, the oxygen sensor must be left with the detector facing down for 1 or 2 minutes or, when the filter is completely dry, more than 12 hours.

Calibration can be performed in two ways; air calibration and 100% O_2 calibration. Both methods are performed on the FiO_2 window.

- Calibration with Air (Simple method)
  Calibrates with air (21% O_2).
  The error margin of the measured value is 3%.
- Calibration with 100% O_2 (Precise method)
  Calibrates with 100% O_2.
  The error margin of the measured value is 2%.

NOTE

The calibrated value is saved in memory in the connector of the FiO_2 connection cord. Once calibrated, you don't need to calibrate again when connecting the FiO_2 connection cord to a different multi-parameter socket.

Calibration with Air (Simple method)

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "FiO_2" key. The FiO_2 window appears.

3. Leave the oxygen sensor in the atmosphere for more than 1 minute.

4. Touch the "AIR CAL" key to start calibration.

When calibration ends, the calibration date and time, and the FiO_2 value '21' are displayed on the FiO_2 window.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Calibration with 100% O_2 (Precise Method)

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "FiO_2" key. The FiO_2 window appears.

3. Apply 100% O_2 flow to the oxygen sensor for more than 1 minute.

4. Touch the "O_2 CAL" and start calibration.

   When calibration ends, the calibration date and time and the FiO_2 value '100' are displayed.

HOME

5. Press the HOME key on the front panel to return to the monitoring screen.

Changing the FiO_2 Alarm Limits

CAUTION

When the upper or lower alarm limit is turned off, there will be no FiO_2 upper or lower alarm for that limit.

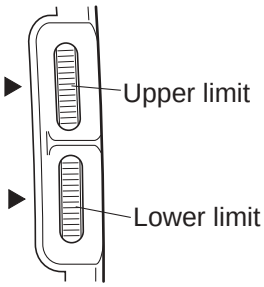
You can set the upper and lower FiO_2 alarm limits on this window. Other alarm items must be set on the VITAL ALARM window. You can set all alarms, including the upper and lower FiO_2 alarm limits, on the VITAL ALARM window (See Section 6).

MENU

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the "FiO_2" key. The FiO_2 window appears.

3. Do one of the following:



Use the function dials to change settings.

Or,

1) Touch the upper limit box to set the upper limit or touch the lower limit box to set the lower limit.

2) Touch the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

Or,

Touch or drag the desired level on the setting bar. Touch the ▲ or ▼ key to adjust the setting.

If the upper limit is set to a value above the maximum or the lower limit is set to a value below the minimum, the alarm is set to OFF.

4. Press the HOME key on the front panel to return to the monitoring screen.

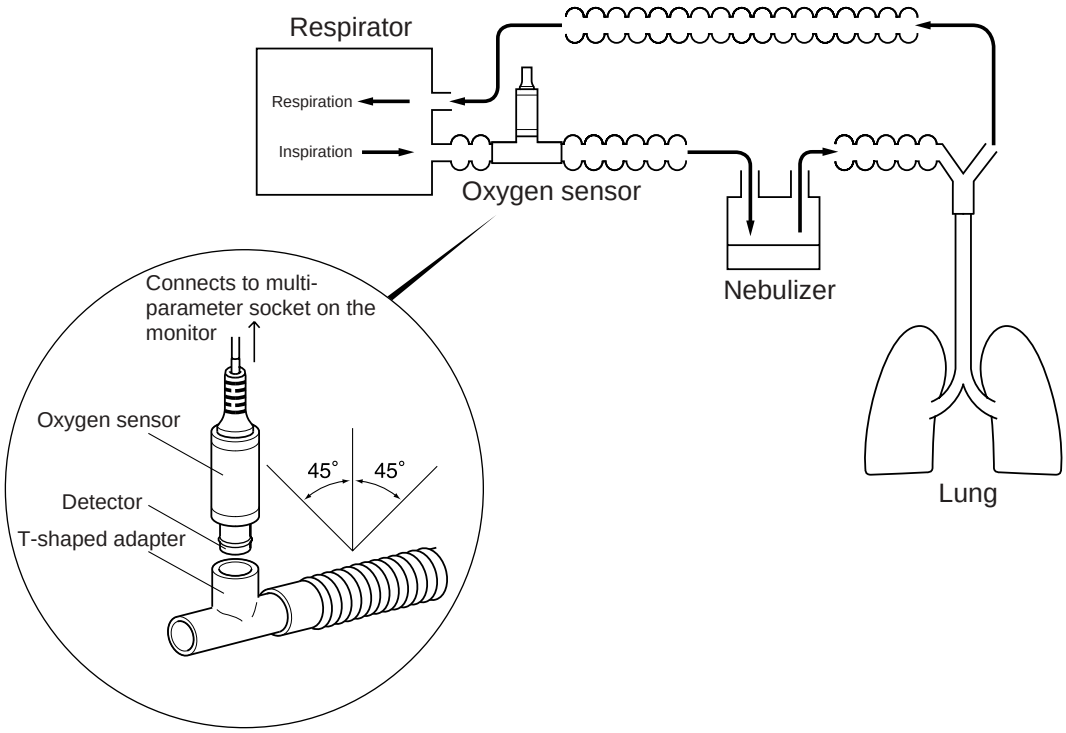
Connecting the Oxygen Sensor to the Inspiration Circuit and Starting Measurement

1. Connect the oxygen sensor to the T-shaped adapter.

2. Connect the T-shaped adapter properly to the inspiration circuit of the respirator, with the detector of the oxygen sensor facing down and the oxygen sensor at an inclination angle within 45° from the respirator vertically.

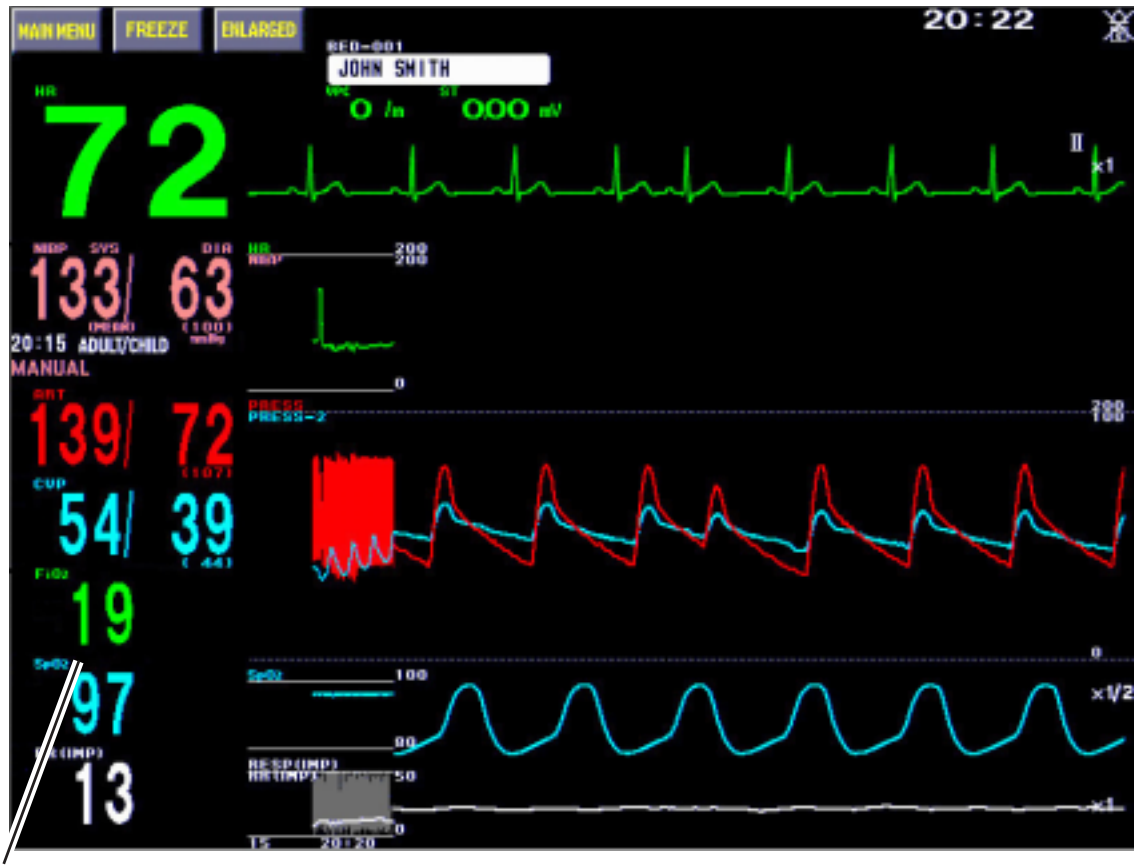
NOTE

Connect the detector of the oxygen sensor facing down. Otherwise, considerable errors in the measured value may occur.



3. After connecting the oxygen sensor, you can start the FiO_2 monitoring.

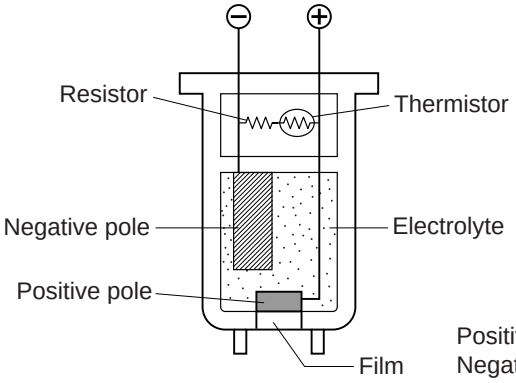
For error messages and monitoring problems, refer to Section 20.


MAIN MENU
FREEZE
ENLARGED
20:22
JOHN SMITH
72
133/ 63
20:15 ADULT/CHILD
MANUAL
139/ 72
54/ 39
19
97
13
FiO_2 value

Principle and Structure of Oxygen Sensor

Structure of Oxygen Sensor

As shown below, the oxygen sensor is composed of an oxygen lead battery using special acidic electrolyte with the oxygen electrode (gold electrode) as the positive pole and the lead electrode as the negative pole. The oxygen in the measured air passes through the non-multiparous fluorine contained resin film and scatters, is electrolytically reduced at the gold electrode, and a current proportional to the oxygen concentration in the atmosphere flows between the two electrodes. This current is detected as the terminal voltage of the resistor and thermistor for temperature compensation, and the oxygen concentration can be measured from the change in the output voltage. (See the graph below.)

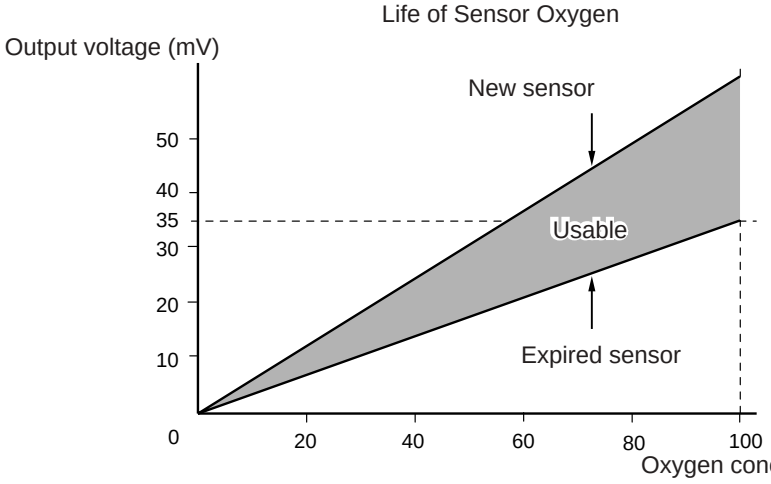


Positive pole: gold electrode
Negative pole: lead electrode

Life Span of Oxygen Sensor

The oxygen sensor wears out after a certain period of time because it is an oxygen battery which generates voltage in reaction to the oxygen in the atmosphere. Its life span depends on the oxygen concentration of the measured atmosphere, and will be shorter when used in places with high oxygen concentration, and longer in places with low oxygen concentration. Since the oxygen sensor outputs voltage proportionate to the oxygen concentration, it has reached the end of its life span when the output voltage can no longer be obtained.

As shown in the below graph, as it nears the end of its life, the output voltage becomes smaller. When the output voltage of the sensor during 100% O_2 calibration is below 35 mV, it is determined to have reached the end of its life.



Precautions when Using the Oxygen Sensor

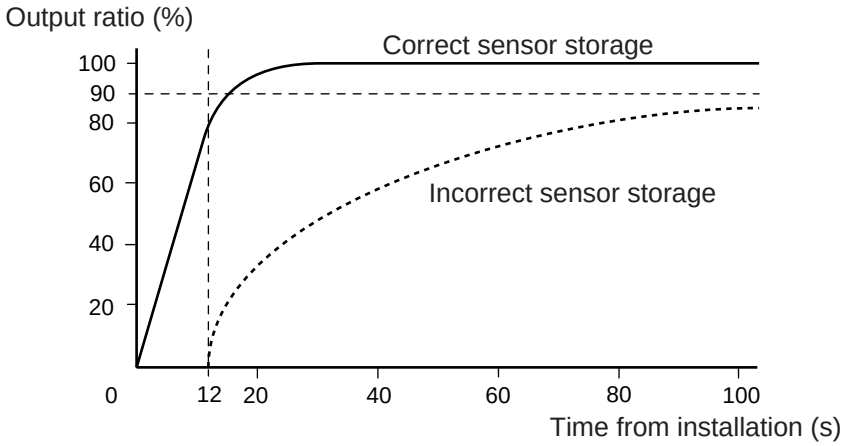
The electrolyte in the oxygen sensor contains air bubbles to protect the film and internal sensor parts from changes in the external voltage of the sensor (changes in atmospheric pressure). It serves as the buffer against pressure.

For this reason, if the detector is not faced down in use, these air bubbles will adhere to the film and electrodes and interfere with electrolytic response in the sensor, disabling correct measurement. Therefore, the detector of the oxygen sensor must be faced down and at an inclination of within 45° vertically in use and storage. Leaving the detector facing up will disable correct measurements for several minutes after the start of measurements.

When using an oxygen sensor not stored with the detector facing down, face the detector down, leave it for several minutes to 12 hours, then perform calibration after the sensor output stabilizes.

The interval for the sensor output to stabilize depends on the state of storage. Refer to the graph below.

Time required for the sensor output to stabilize



Section 20 Error Messages and Troubleshooting

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Monitoring

Messages

Screen Message	Possible Cause/Criteria	Action
XXXX ALARM	Alarm concerning the XXXX (parameter name) occurred.	Press the HOME key to display the monitoring screen. Check the error message. Perform the countermeasure referring to the parameter error message section.
ALARM bed name	Alarm occurred on an interbed bed.	Check the data of the interbed bed on the INTERBED window and remove the cause.
BATTERY WEAK	Battery is fully discharged.	Replace the battery with a fully charged battery or use AC power.
CALIBRATING	The “CAL” key on the screen was touched.	Release the “CAL” key when calibration is not necessary.
CLOCK IC FAILURE	The clock circuit is damaged.	Contact your Nihon Kohden distributor.
CONNECTOR OFF	The connection cord of the monitoring parameter is disconnected from the monitor.	Connect the connection cord properly. When monitoring the parameter of the disconnected cord is not necessary, press the SILENCE ALARMS key to silence the alarm.
	The connection cord is damaged.	Replace the connection cord with a new one.
FREEZE	The waveforms are frozen.	To unfreeze the waveforms: • Press any key on the screen • Press any key on the front panel • The waveforms are unfreezed 3 minutes after freezing
PARAMETER DUPLICATED	More than the specified number of channels are used for a parameter.	Only use the specified number of channels.
REMAINING SUSPEND TIME	The SILENCE ALARMS key was pressed before alarm occurrence.	To cancel alarm suspension, press the SILENCE ALARMS key again.
SILENCE ALARMS	The SILENCE ALARMS key was pressed to silence the alarm.	• When the alarmed cause is resolved, the alarm is cleared. • When the SILENCE ALARMS key is pressed during alarm suspension, all alarms are resumed.
SILENCE DIFFERENT ALARMS	Another alarm occurred during alarm suspension and the SILENCE ALARMS key was pressed to silence that alarm.	• When the alarmed cause is resolved, the alarm is cleared. • When the SILENCE ALARMS key is pressed during alarm suspension, all alarms are resumed.
TOUCH KEY OFF	The touch screen key function is turned off.	To enable the touch screen keys: • Press any key on the front panel • Turn the function dial • The touch screen key function resumes 3 minutes after disabling the touch screen key function
PRINTING	Printing now	---
AUTO LEAD CHANGE	Monitoring lead is being changed by auto lead change function.	---

Problems

Trouble	Possible Cause/Criteria	Action
The screen is dark.	The brightness of the screen is not appropriate.	Adjust the setting on the SOUND & BRIGHT window.
	The backlight is old.	Contact your Nihon Kohden distributor.
	The monitor is operating on battery.	If necessary, set POWER SAVE MODE on the SYSTEM SETUP screen to OFF.
No sync sound.	The sync sound setting is turned OFF.	Set the sync sound to ON on the SOUND & BRIGHT window.
	The sync sound volume is turned down.	Adjust the volume setting on the SOUND & BRIGHT window.
	The sleep mode is turned on.	The sleep mode is turned off when: • An alarm occurs • The touch screen is touched • Key on the front panel is pressed • Function dial is turned
The time displayed on the upper right corner of the screen is not correct.	The date and time setting is not correct.	Set the correct date and time on the DATE & TIME window.
	The backup battery is old.	Check the date and time setting on the DATE & TIME window and turn the power of the monitor off and on. If the time is incorrect, replace the battery with a new one. Contact your Nihon Kohden distributor.
The monitor is too hot.	The vent hole is obstructed.	Remove the cause.
The touch screen keys do not function.	The pressed position and activated position do not match.	Calibrate the touch screen.
The monitor only operates for about 30 minutes with a fully charged battery.	The battery pack is old.	Replace the battery pack with a fully charged new one.
Some part of the review data is deleted or the time is incorrect.	The monitor is turned off during the system check screen display.	The remaining data may not be reliable. Delete all data.

Network

Messages

Screen Message	Possible Cause/Criteria	Action
INSERT NETWORK CARD	The QI-101P network card or QI-111P network printer card is removed from the monitor.	Insert the QI-101P network card or QI-111P network printer card into the monitor properly. When not connecting the monitor to a network, press the SILENCE ALARMS key to silence the alarm.
NETWORK CARD ERROR	The QI-101P network card or QI-111P network printer card failure.	Contact your Nihon Kohden distributor.
	• The monitor is connected to a central monitor and is sending waveform(s) to the central monitor. Or • The monitor is connected to a network and is monitored by another bedside monitor with the interbed function. Check that the monitor data are properly monitored on the receiving instrument. It takes about one minute for this icon to disappear after all the receiving instruments are turned off or all the receiving instruments stop monitoring this monitor with the interbed function.	—
	The QI-111P network printer card is inserted into the monitor.	—

Problems

Trouble	Possible Cause/Criteria	Action
The monitor cannot be connected to the network (the icon or icon does not appear on the screen).	The network card is not inserted into the monitor properly.	Insert the network card into the monitor properly. Refer to Section 2.
	The network cable is not connected to the network card properly.	Connect the network cable to the network card properly. Refer to Section 2.
	The network settings are not correct.	Set the correct network settings on the NETWORK SETUP of the SYSTEM SETUP screen. Refer to Section 3.
The monitor cannot be connected to the network (the icon does not appear on the screen).	The monitor is not selected as a monitored bed on the central monitor or receiving instrument.	Select the monitor as a monitored bed on the central monitor or receiving instrument.
	Discontinuity in the network cable or faulty hub.	Replace the network cable or the hub with a new one.
	The connector on the network card is damaged.	Contact your Nihon Kohden distributor.
The patient name which is entered on the FREE window disappeared.	When the monitor is connected to the network, the FREE window is not available. The patient name entered from the FREE window is deleted when the monitor is connected to the network.	Enter the patient name on the KEYBOARD window.
The FREE window of the PATIENT INFO window cannot be displayed.		When the monitor does not need to be connected to the network, remove the network card from the monitor.

Recording

Messages

Screen Message	Possible Cause/Criteria	Action
CLOSE PAPER MAGAZINE	The paper magazine is open.	Push the paper magazine closed until it clicks.
INSERT REC PAPER	No recording paper.	Load the recording paper. Refer to Section 2.
	The recording paper is not loaded correctly.	Correctly load the recording paper. Refer to Section 2.
	Data is recorded.	To stop recording, press the record key on the front panel.

Problems

Trouble	Possible Cause/Criteria	Action
There is no printing (only paper feeding).	The recording paper is upside down.	Reload the recording paper into the paper magazine correctly. Refer to Section 2.
Waveforms can be recorded but the trend and list recording cannot.	Dust in the sensor inside the paper magazine.	Clean the surface of the sensor inside the paper magazine with a dry cotton swab. See Section 21.
Printing is faint.	The NK-specified paper is not used.	Use the FQW50-3-100 recording paper.
	The thermal head is dirty.	Clean the thermal head with the provided thermal head cleaning pen.
Dots are missing.	The thermal head is dirty.	Clean the thermal head with the provided thermal head cleaning pen.
Recording suddenly starts without key operation.	Alarm recording or periodic recording mode is set to ON.	Set the alarm recording or periodic recording mode on the RECORDING window to OFF if not needed. Press the record key on the front panel to stop recording.
No paper is feeding.	The paper magazine is open.	Push the paper magazine closed until it clicks.
	Dust may have collected in the gears.	Contact your Nihon Kohden distributor.
Recorder operates only some of the time.	Dust in the sensor inside the paper magazine.	Clean the surface of the sensor inside the magazine with a dry cotton swab.

ECG Monitoring

Messages

Screen Message	Possible Cause/Criteria	Action
ARRHYTHMIA ANALYSIS OFF	ARRHYTHMIA ANALYSIS on the ECG window is set to OFF.	If arrhythmia analysis is necessary, set ARRHYTHMIA ANALYSIS on the ECG window to ON.
ATTACH ELECTRODES	The monitor is in STANDBY MODE and waiting for the electrodes to be attached to the patient.	Attach electrodes to the patient.
CHECK ELECTRODES	The electrode lead is detached from the electrode.	Connect the electrode lead to the electrode firmly.
	The electrode cannot be attached firmly to the skin.	Replace the electrode with a new one.
	The electrode lead is disconnected from the ECG connection cord.	Connect the electrode lead to the ECG connection cord.
	The contact between the lead and electrode is poor.	Clean the electrode lead clip or replace the electrode lead with a new one.
	The NUMBER OF ELECTRODES setting on the ECG window is not correct.	Set the correct number for the NUMBER OF ELECTRODES setting.
	The electrode lead is damaged.	Replace the electrode lead with a new one.
	Differential offset voltage at electrodes.	Replace the electrode with a new one.
LEARNING	Started learning QRS for arrhythmia analysis.	Wait for the learning to complete.
NOISE	The baseline is not stable due to respiration or body movement.	Change the electrode position.
	EMG noise is superimposed.	Change the electrode position to where there is less muscle.
	The electrode is pulled by the lead.	Put some slack into the electrode lead.
	The electrode is dry.	Replace the electrode with a new one.
	The contact between the lead and electrode is poor.	Clean the electrode lead clip or replace the electrode lead with a new one.
	High electrode impedance.	Rub the skin with “skinPure” skin preparation gel.
	An electric blanket is used.	Use another warming method.
	Equipment which emits strong electromagnetic interference is nearby. e.g. ESU, cellular phone.	Keep the interference source away from the monitor or turn off the emitter source power. When using the ESU, refer to “Use with an Electrosurgical Unit” in Section 11.
	Equipotential grounding is not acquired.	Connect the equipotential ground terminal on the monitor to the equipotential ground terminal on the wall with the grounding lead.
PACING (This message appears only when PACING DETECTION is set to ON on the ECG window.)	Pacing QRS is detected.	When the patient does not have an implanted cardiac pacemaker, set the PACING DETECTION to OFF on the ECG window.
	An electric blanket is used.	Use another warming method.
	ECG of a neonate is monitored.	Set the PACING DETECTION to OFF on the ECG window.

Problems

Trouble	Possible Cause/Criteria	Action
The heart rate is inaccurate.	The QRS amplitude is small.	Change the sensitivity so that the QRS amplitude is larger than 1 cm.
	The QRS is not detected correctly.	Change to a lead which provides good QRS.
		Change the lead or electrode position so that the QRS is large and T wave is small.
	PACING DETECTION setting on the ECG window is not appropriate.	When the patient does not have an implanted cardiac pacemaker or neonate's ECG is monitored, set PACING DETECTION to OFF.
The arrhythmia alarm occurs frequently when heart rate is normal.	The dominant QRS is not appropriate for arrhythmia monitoring.	Re-learn the patient ECG or change the dominant QRS.
	Patient moved or EMG noise is superimposed.	Change the electrode position to where there is less muscle.
ECG waveform does not appear on the screen when electrodes are attached properly.	NUMBER OF ELECTRODES setting on the ECG window is not correct.	Set the correct number for NUMBER OF ELECTRODES setting.
AC interference on the ECG waveform.	An electrical blanket is used.	Use another warming method or place a shield cover around the electrical blanket.
	The electrode is dry.	Replace the electrode with a new one.
	FILTERS on the ECG window is set to DIAG.	Set FILTERS to MONITOR.
Baseline wandering.	The baseline is not stable due to respiration or body movement.	Change the electrode position to where there is less muscle.
	The electrode is dry.	Replace the electrode with a new one.
	The contact resistance between the skin and electrode is high.	Rub the skin with "skinPure" skin preparation gel.
	FILTERS on the ECG window is set to MONITOR or DIAG.	Set FILTERS to MAXIMUM.

Respiration Monitoring

Messages

Screen Message	Possible Cause/Criteria	Action
APNEA	Apnea exceeded the apnea alarm limit.	————
RESP OFF (Impedance)	IMP RESP MEASURE on the RESP window is set to OFF.	When monitoring respiration by impedance method is necessary, set IMP RESP MEASURE to ON.
CHECK SENSOR (Thermistor)	The respiration pickup is damaged.	Replace the respiration pickup with a new one.

Problems in Impedance Method

Trouble	Possible Cause/Criteria	Action
The respiration waveform is not displayed on the screen.	IMP RESP MEASURE on the RESP window is set to OFF.	Set IMP RESP MEASURE to ON.
	Electrodes, electrode leads, ECG connection cord are not connected correctly.	Connect them properly.
	The electrode is dry.	Replace the electrode with a new one.
	The skin-electrode contact impedance is high.	Reduce the impedance by using “skinPure” skin preparation gel.
The respiration waveform and respiration rate are not stable.	The electrode positions are not appropriate for measuring respiration.	Check the attached position of the electrodes.
	The electrode is dry.	Replace the electrode with a new one.
	NOISE REDUCTION ON IMPEDANCE RESP is set to OFF and the respiration waveform amplitude is too small.	Change the sensitivity so that the amplitude is larger than 10 mm.
	NOISE REDUCTION ON IMPEDANCE RESP is set to ON and the timing of the respiration and heart rate coincide.	Set NOISE REDUCTION ON IMPEDANCE RESP to OFF on the SYSTEM SETUP screen.

Problems in Thermistor Method

Trouble	Possible Cause/Criteria	Action
The respiration waveform is not displayed on the screen.	Malfunction of the respiration pickup.	Replace the respiration pickup with a new one.
The amplitude of the respiration waveform is small or becomes a baseline.	When measuring at the nostrils, the position of the respiration pickup is not appropriate.	Attach the respiration pickup to a position where sufficient temperature changes can be seen.
	The respiration pickup for nose is used for measuring a patient with trachea tube inserted.	Measure with a respiration pickup for airway.
	The temperature difference between inspiration and expiration is small due to increase in temperature of the inspired air.	Use the impedance method.
The expiration and inspiration phases are reversed.	The inspiration temperature is higher than the expiration temperature.	Use the impedance method.
The respiration rate is not accurate.	NOISE REDUCTION ON IMPEDANCE RESP is set to OFF and the respiration waveform amplitude is too small.	Change the sensitivity so that the amplitude is larger than 10 mm.
	NOISE REDUCTION ON IMPEDANCE RESP is set to ON.	Set NOISE REDUCTION ON IMPEDANCE RESP to OFF on the SYSTEM SETUP screen.

SpO_2 Monitoring

Messages

Messages	Probable Causes	Action
ATTACH PROBE	The monitor is in STANDBY MODE and waiting for the probe to be attached to the patient.	Attach the probe to the patient.
CHANGE PROBE	Probe is expired.	Replace the probe with a new one.
	Probe is damaged or short-circuited.	Replace the probe with a new one.
	SpO2 connection cord is damaged.	Replace the SpO2 connection cord with a new one.
CHECK PROBE	The probe cable is disconnected from the SpO2 connection cord.	Connect the probe cable to the SpO2 connection cord. If SpO2 monitoring is not necessary, press the SILENCE ALARMS key.
	The probe is not attached to the patient properly.	Attach the probe to the patient properly.
	The probe is broken or short-circuited.	Replace the probe with a new one. If the message still appears, replace the SpO2 connection cord with a new one.
CHECK PROBE SITE	The probe is not attached at the appropriate site.	Attach the probe to a site 6 to 14 mm thick.
	The probe has expired.	Replace the probe with a new one.
	Considerable body movement.	When the message is displayed frequently, check the patient condition and, if necessary, change the attachment site.
	The probe is not attached to the patient properly.	
NO PULSE	Poor blood circulation for measuring the SpO2 value.	Check the patient condition, probe attachment or change the attachment site.
	The probe is attached too tightly and is obstructing the blood circulation.	Reattach the probe.
	The probe is not attached to the patient properly.	Attach the probe to the patient properly.
PULSE SEARCH	Searching for the correct pulse wave.	Wait until the pulse wave is detected.
	The SpO2 value cannot be obtained because the waveform is unstable.	Check the probe attachment.
	The probe is not attached to the patient properly.	Attach the probe to the patient properly.
	Poor blood circulation for measuring SpO2.	Check the patient condition, probe attachment or change the attachment site.
	The probe is secured too tightly and it is obstructing the blood circulation.	Reattach the probe.
	The probe is disconnected from the SpO2 connection cord.	Connect the probe to the SpO2 connection cord.
	The finger probe is not attached to the patient properly.	Attach the finger probe firmly to the patient.
SpO2 MODULE ERROR	SpO2 hardware malfunction.	Turn off the monitor power, wait for a few minutes and turn on the power again. If the message still appears, contact your Nihon Kohden distributor.
WEAK PULSE	Poor peripheral circulation.	Check the patient condition and change the attachment site.
	The probe is attached too tightly and is obstructing the blood circulation.	Reattach the probe.

Problems

Trouble	Possible Cause/Criteria	Action
Unstable SpO_2 value.	The probe size is inappropriate.	Use the correct size probe.
	The probe is attached to the same limb that is used for NIBP or IBP measurement.	Attach the probe to the other limb.
	An ESU is used.	Locate the ESU as far as possible from the probe and wait until the pulse wave stabilizes.
	Measuring on the venous pulse.	Cannot measure correctly.
SpO_2 value on the monitor and CO oximeter do not match.	The probe is not attached properly.	Attach the probe correctly. (The emitter and detector of the probe must face each other.)
	The attachment site is inappropriate.	Attach the probe to a site 6 to 14 mm thick.
	The measuring site is not clean.	If necessary, remove nail polish and clean the measuring site.
	Too much abnormal hemoglobin (HbCO, MetHB, etc.).	Cannot measure correctly.
	Dye (methylene blue or indocyanine green) is injected in the blood.	Cannot measure correctly.
	Measuring during CPR.	Cannot measure correctly.
Probe is damaged.	Probe is disinfected by an unspecified procedure.	Disinfect the probe using the specified method.
	The probe is repeatedly used.	Replace the probe with a new one when the expiration date passes.
Sine-wave noise on the pulse wave	Light interference.	Cover the attachment site with a blanket.
	The line frequency setting on the monitor is not correct.	Set the correct line frequency on the monitor.

NIBP Monitoring

Messages

Screen Message	Possible Cause/Criteria	Action
AIR LEAK	The cuff pressure does not change after inflation even after a certain period of time.	Connect the cuff to the air hose properly.
		Connect the air hose to the socket properly.
	The cuff or air hose is damaged.	Replace the cuff or air hose with a new one.
CANNOT DETECT PULSE	The patient's pulse wave is small.	Measure by palpation or the invasive blood pressure method.
	The cuff is not wrapped to the patient correctly.	Wrap the cuff around the arm of the patient properly.
CUFF OCCLUSION	The cuff pressure does not decrease after measurement has completed.	Check that the air hose is not bent or squeezed.
HIGH CUFF PRESS	Enormous pressure was applied by the pressure of the cuff.	When measuring an adult, ask the patient not to move too much.
INFLATION PRESS LOW	Insufficient cuff inflation pressure.	Wait until the cuff pressure rises.
MEAS TIME-OUT	The measuring time exceeded the specified time due to arrhythmia or noise.	If the cause is arrhythmia, measure by invasive blood pressure measurement. Remove the cause if due to noise.
NIBP MODE CHANGED	Cuff type is changed.	Check that the correct cuff type is used.
NIBP MODULE FAILURE	Module malfunction.	Contact your Nihon Kohden distributor.
NIBP SAFETY CIRCUIT RUNNING (When this message is displayed, measurement cannot be performed for 40 seconds.)	The hose is bent	Check that the hose is not bent.
	The inflation time is too long.	Stop measurement.
	In auto mode measurement, the cuff inflation started before the cuff deflation is complete.	Stop measurement.
PLEASE WAIT	Measurement started before the cuff inflation pressure was deflated enough.	Check the cuff pressure before starting measurements. When measuring using the adult cuff: below 15 mmHg When measuring using the cuff for neonates: below 3 mmHg
REMEASURING (Remeasurement is automatically performed. If the message still appears, after remeasurement, do the counter actions.)	The cuff is not attached to the patient.	Attach the cuff to the patient.
	Patient moved during measurement.	Wait for the patient to stop moving, then measure again.
	Patient's pulse is too small.	Measure by palpation or the invasive blood pressure method.
	The cuff is not attached properly.	Attach the cuff properly.
	The cuff size is not appropriate.	Check that the cuff of the correct size is used.
	Patient's pulse and heart rate is unstable.	Wait for the patient to relax and stop moving.
SYSTOLIC OVER	The maximum blood pressure exceeded 280 mmHg when using the adult cuff, or 150 mmHg when using the neonate cuff.	Measure by palpation or the invasive blood pressure method.
WEAK PULSE	The patient's pulse wave is too small.	Measure by palpation or the invasive-blood pressure method.
	The cuff is wrapped too loosely.	Wrap the cuff around the arm properly.
	The cuff size is inappropriate.	Use the appropriate cuff.
ZEROING	NIBP zero balance adjustment is being performed.	Do not touch the cuff during zeroing and wait for the message to disappear.

Problems

Trouble	Possible Cause/Criteria	Action
Cuff inflation pressure is less than 10 mmHg or NIBP data display disappears for a few seconds.	The cuff hose is not connected to the cuff socket properly.	Connect the cuff hose to the socket properly.
	The cuff is not wrapped around the arm or is wrapped too loosely.	Wrap the cuff around the upper arm.
The cuff does not inflate when the NIBP START/STOP key is pressed.	The cuff hose is not connected to the cuff socket.	Connect the cuff hose to the socket firmly.
	The cuff hose or air hose may be folded or squeezed when the cuff pressure display on the screen increases quickly but the actual cuff does not inflate.	Check the cuff hose and air hose.
Abnormal measurement results are displayed.	The cuff size is not correct.	Select the cuff which fits the patient's limb circumference.
	The cuff is not wrapped around the arm correctly.	Wrap the cuff around the upper arm, not too tightly or too loosely.
	NIBP data is not correct because of body movement.	Prevent the patient from moving during measurement.
	Measurement on the wrong site.	Measure NIBP at the correct site.
The cuff is suddenly deflated during inflation.	The NIBP START/STOP key is pressed during inflation.	———
Auto measurement does not start even when the time interval has passed.	The time interval for the NIBP auto measurement is set incorrectly.	Set the correct time interval.
The cuff suddenly inflates.	The measurement mode is set to auto mode.	Check the time interval.
	NIBP measurement is triggered by PWTT.	Set PWTT on the NIBP window to OFF when measuring NIBP with PWTT is not necessary.
Cannot connect cuff to the air hose.	Unspecified cuff is used.	Use a cuff specified by Nihon Kohden.
Cannot measure NIBP.	Noise which disables calculation of the blood pressure has interfered.	Remove the cause.
	The pulse wave is unstable due to arrhythmia.	Ask the patient not to move too much and perform invasive blood pressure measurement as required.
	The air hose is bent or squeezed.	Remove the cause.
	The cuff has worn out.	Use a new cuff.
Blood congestion occurs.	Measuring over a long period of time at intervals less than 2.5 minutes.	Increase the measuring interval.
		Do not measure NIBP over a long time.
Thrombus occurs.	Measuring a sickle anemia patient.	Do not perform NIBP measurement on a sickle anemia patient.
NIBP data on the screen is dark.	OLD NIBP DATA is set to DIM on the SYSTEM SETUP screen and the time set at OLD NIBP AFTER has elapsed since the last measurement.	When NIBP is measured again, the data is displayed in normal brightness.

IBP Monitoring

Messages

Screen Message	Possible Cause/Criteria	Action
CHECK SENSOR	The blood pressure transducer is disconnected from the IBP connection cord.	Connect the blood pressure transducer to the IBP connection cord properly.
	Malfunction of the blood pressure transducer.	Replace the blood pressure transducer with a new one.
	The IBP connection cord is damaged.	Replace the IBP connection cord with a new one.
OUT OF RANGE	The measured value is outside the measuring range.	Check the measuring environment.
	Malfunction of the blood pressure transducer.	Replace the blood pressure transducer with a new one.
ZERO IMBALANCE	Zero balance is not adjusted.	Adjust the zero balance.
ZERO OUT OF RANGE	Malfunction of the blood pressure transducer.	Replace the blood pressure transducer with a new one.
	Monitor malfunction.	Contact your Nihon Kohden distributor.
ZERO UNSTABLE	The circuit is not exposed to air during zero balance adjustment.	Expose the circuit to air and perform zero balance adjustment again.
	The pressure of zero balance is unstable.	Re-connect the circuit and perform zero balance adjustment again.
ZEROING COMPLETE	Zero balance adjustment is complete.	IBP monitoring is available.

Problems

Trouble	Possible Cause/Criteria	Action
The acquired blood pressure value is different from the estimated value.	Air bubbles remain in the circuit.	Remove the air bubbles.
	An extra tube is connected in the circuit.	Remove the extra tube.
	The position of the blood pressure transducer is inappropriate.	Check the position of the blood pressure transducer.
	A blood pressure transducer with different sensitivities is used.	Check the blood pressure transducer.
	Other causes.	Perform zero balance adjustment again.
No invasive blood pressure value appears on the screen.	The measurement is out of range.	Check the measuring condition.
	The blood pressure transducer is damaged.	Replace the blood pressure transducer with a new one.

Temperature Monitoring

Messages

Screen Message	Possible Cause/Criteria	Action
CHECK TEMP1/TEMP2 SENSOR	The probe is disconnected from the temperature connection cord.	Connect the probe to the temperature connection cord properly.
	The temperature connection cord is damaged.	Replace the temperature connection cord with a new one.
	The measured value is outside the measuring range.	Check the probe attachment site.

Problems

Trouble	Possible Cause/Criteria	Action
The temperature value is not displayed on the screen.	The temperature probe is faulty.	Replace the temperature probe with a new one.
	Monitor malfunction.	Contact your Nihon Kohden distributor.

CO Monitoring

Messages

Screen Message	Possible Cause/Criteria	Action
BASELINE DRIFT	Physiological change.	Increase the injectate volume or cool the injectate.
	Using respirator.	Adjust the respiration phases.
	Injection interval is short.	Increase the injection interval.
	Noise interference from external devices.	Place external devices as fas as possible from the catheter.
DETECTING BASELINE	Searching for the baseline of the blood temperature.	Wait for the baseline of the blood temperature to be detected.
INFLATE BALLOON	Balloon is not inflated.	Inflate the balloon.
INJECT	Injectate is not injected or the monitor does not acknowledge that injectate is injected.	Inject the injectate. The monitor has not acknowledged the injection if the “MEASURING CO” message is not displayed on the CO window even when the injectate is injected. Inject the injectate again.
INJECTION TIME OUT	The injectate is not detected for more than 4 minutes after the “INJECT” message was displayed (or 30 seconds after the “MANUAL START” key is pressed).	Touch the “MANUAL START” key and inject the injectate within 30 seconds.
MEASURING CO	Measuring the CO.	Wait for the calculation to be completed.
OUT OF RANGE	Calculated a value outside the measuring range.	If the catheter retaining condition is not appropriate, the temperature change becomes small and the CO value may be outside the measuring range. Check the catheter retaining condition and the coefficient value setting.
	The coefficient value of the injectate temperature is not specified by the catheter manufacturer.	Make sure the injectate temperature is within the range specified by the manufacturer. For example, when using a Becton Dickinson catheter, the coefficient values for the injectate temperature between 5 and 18°C are not specified so do not use an injectate temperature between 5 and 18°C.
Tb OFF	The catheter is not connected to the CO connection cord.	Connect the catheter to the CO connection cord properly.
	The catheter is faulty.	Replace the catheter with a new one.
	The CO connection cord is damaged.	Replace the CO connection cord with a new one.
Tb TEMP ERROR	The blood temperature is below 15°C or above 45°C.	————
	The catheter is faulty.	Replace the catheter with a new one.
THERMODILUTION CURVE ERROR	Returned to the baseline of the thermodilution curve too late.	Use the appropriate injection method.
	Possible endocardial shunt.	Check the accuracy of the measured value.
Ti TEMP ERROR	The injectate is not cooled or the room temperature is above 27°C.	Cool the injectate or decrease the room temperature.
	The bath probe or inline sensor is faulty.	Replace the probe or sensor with a new one.

Problems

Trouble	Possible Cause/Criteria	Action
Infarction occurs.	The balloon burst.	Remove the catheter from the patient, treat the infarction and insert the new catheter into the patient. Check that the balloon is not damaged before use.

CO_2 Monitoring

Messages

Screen Message	Possible Cause/Criteria	Action
APNEA	Apnea exceeded the apnea alarm limit.	————
CAL?? (when using TG-950P CO2 sensor kit)	Zero calibration is not performed.	Perform zero calibration.
CHANGE ADAPTER	The CO2 adapter is damaged.	Replace the CO2 adapter with a new one.
CHANGE SENSOR	The CO2 sensor is damaged.	Replace the CO2 sensor with a new one.
CHECK SENSOR	Insufficient sensor light.	Refer to the CO2 sensor kit manual. If necessary, replace the kit with a new one.
CO2 AUTO ZERO (when using TG-900P CO2 sensor kit)	Zero calibration is automatically performed during apnea alarm.	Press the SILENCE ALARMS key to silence the alarm.

Problems

When Using TG-900P CO_2 Sensor Kit

Problem	Probable Causes	Action
The measured value is low.	CO_2 is mixed in the inspiration.	Refer to the “Measurement Errors” section.
	The airway adapter is dirty.	Replace the airway adapter with a new one.
	The measurement is performed where atmospheric pressure is low, such as at high altitude.	Consider the atmospheric pressure when making evaluations.
The measured value is high (Error is about 8 mmHg).	Anesthetic gas is used. O_2: 4 L/min, N_2O: 2 L/min, sevoflurane: 1%	Set the correct inspired gas composition.
The measured value is inaccurate.	Oscillation.	Check the respirator and remove the cause.
	Currently doing suctioning.	After completing suction, wait for at least 20 seconds for the correct value to appear.
	The Jackson Rees respiration circuit or Mapleson D respiration circuit is connected to the patient.	Cannot measure correctly.
	The respiration rate of the patient is very high or respiration is irregular.	Cannot measure correctly.
The respiration waveform does not appear.	Oscillation.	Check the respirator and remove the cause.
	The airway adapter is disconnected from the CO_2 sensor kit.	Connect the airway adapter to the CO_2 sensor kit.
The red LED on the CO_2 adapter blinks.	CO_2 sensor or CO_2 adapter is faulty.	Replace the CO_2 sensor or CO_2 adapter with a new one.
	Apnea for longer than 20 s.	The red LED blinks when apnea is longer than 20 s regardless of the alarm setting on the monitor.

When Using TG-950P CO_2 Sensor Kit

Problem	Probable Causes	Action
The measured value is low.	Zero calibration is not performed.	Calibrate the airway adapter.
	The airway adapter is dirty.	Replace the airway adapter with a new one.
The measured value is high (Error is about 8 mmHg).	Anesthetic gas is used. O_2: 4 L/min, N_2O: 2 L/min, sevoflurane: 1%	Set the correct inspired gas composition.
The measured value is inaccurate.	Oscillation.	Check the respirator and remove the cause.
	The respiration rate of the patient is very high or respiration is irregular.	Cannot measure correctly.
The respiration waveform does not appear.	The airway adapter is disconnected from the CO_2 sensor kit.	Connect the airway adapter to the CO_2 sensor kit.

FiO_2 Monitoring

Messages

Screen Message	Possible Cause/Criteria	Action
CAL??	The oxygen sensor is not calibrated.	Calibrate the oxygen sensor.
	The oxygen sensor has reached the end of its life.	Replace the oxygen sensor with a new one.
	The oxygen sensor is not connected properly.	Check the connection of the oxygen sensor, wait for more than 1 minute and then calibrate again. If the problem still occurs, replace the oxygen sensor with a new one.
	Calibration is performed when the oxygen sensor is not stable.	
	The calibration mode is not appropriate.	Select the correct calibration mode.
CALIBRATING	Calibrating the oxygen sensor.	Wait for the calibration to be completed.
CHECK SENSOR	The oxygen sensor is disconnected from the FiO2 connection cord.	Connect the oxygen sensor to the FiO2 connection cord properly.
	The FiO2 connection cord is damaged.	Replace the FiO2 connection cord with a new one.
	The oxygen sensor is damaged.	Replace the oxygen sensor with a new one.

Problems

Trouble	Possible Cause/Criteria	Action
The measured value is abnormal.	The direction of the oxygen sensor changed considerably after calibration.	Face the oxygen sensor downwards and calibrate again.
	Peripheral equipment problem.	Check the state of the equipment connected to the patient.

Section 21 Maintenance

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This section explains how to clean and care for your monitor to ensure reliability and many years of excellent operating condition. Cleaning and disinfecting probes, sensors and cables are also explained in this section.

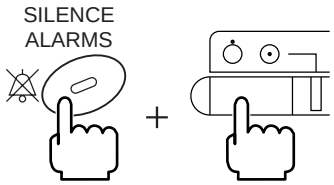
CAUTION

- **Do not disassemble the monitor. Disassembly must be performed by a qualified service personnel.**
- **Fuses should be replaced by qualified service personnel.**

Calibrating the Touch Screen

Calibrate the touch screen when the pressed position and the activated position do not match.

1. Turn the monitor power off.



2. Press the power switch while pressing the SILENCE ALARMS key on the front panel until the DIAGNOSTIC CHECK screen is displayed.

3. Press the MENU key on the front panel. The TOUCH PANEL CALIBRATION screen appears.

4. Touch the exact center of the mark with the touch pen for more than 2 seconds. When the mark is correctly touched, the mark appears on another place. The mark appears in 9 places.

   When all the 9 places are touched correctly, the “CALIBRATION SUCCESSFUL” message appears.

NOTE

Make sure to touch the exact center of every mark and check that the “CALIBRATION SUCCESSFUL” message appears on the screen. If the touch screen calibration is interrupted, the pressed position and the activated position do not match. If this occurs, calibrate the touch screen again.

5. Press the HOME key on the front panel to display the DIAGNOSTIC CHECK screen.

6. Touch the “MONITOR MODE” key on the DIAGNOSTIC CHECK screen to display the monitoring screen.

Cleaning the Touch Screen

When cleaning the touch screen during monitoring, turn the touchkey function off before cleaning. The touchkey function is turned off for 3 minutes or until it is turned on again.

Turning Touchkey Function On or Off

1. Press the MENU key on the front panel to display the MENU window.

2. Touch the “TOUCHKEY OFF” key to display the TOUCHKEY OFF window.

3. Touch the “YES” key to turn the touchkey function off.

   Touch the “NO” key to not turn the touchkey function off.

To turn on the touchkey function on again, do one of the following.

- Press the SILENCE ALARMS key
- Press the MENU key
- Press the HOME key
- Press the record key
- Turn the function dial

Cleaning the Touch Screen

NOTE

- **Do not use a dry or rough cloth.**
- **Do not use acidic, alkaline detergents or alcohol other than ethanol or isopropyl.**

Clean the touch screen using a dry soft cloth or a cloth which is moistened with neutral detergent and wrung out.

Handling Accessories After Use

Battery Pack

Battery Lifetime

The battery pack can be used for about 200 cycles of full discharging/charging.

Replacing Battery Pack

Replace the battery pack with a new one after 200 cycles of discharging/charging or after one year whichever comes first.

Disposal of Battery Pack

Before disposing of the battery, check with your local solid waste officials for details in your area for recycling options or proper disposal. The battery is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream.

ECG and Respiration in Impedance Method

Electrodes

For handling the electrodes, refer to the electrode manual.

Disposing of Electrodes

Follow your local laws for disposing of medical waste.

Cleaning and Disinfecting the Electrode Lead and ECG Connection Cord

NOTE

- **Do not touch the connector pin.**
- **Do not wet the connector.**

Cleaning

Wipe the electrode lead and ECG connection cord with a soft cloth moistened with neutral soap, water or alcohol and wipe with a dry cloth or gauze.

Disinfecting

To disinfect the electrode lead and ECG connection cord, wipe them with a non-abrasive cloth moistened with any of the disinfectants listed below. Use the recommended concentration.

Disinfectant	Concentration (%)
Chlorohexidine gluconate solution	0.5
Benzethonium chloride solution	0.2
Glutaraldehyde solution	2.0
Benzalkonium chloride	0.2
Hydrochloric alkyldiaminoethylglycine	0.5

Respiration in Thermistor Method

Cleaning and Disinfecting the Respiration Pickup

CAUTION

- **The respiration pickup is not waterproof. Do not immerse it directly into chemical liquids or water.**
- **Cover the yellow connector of the respiration pickup with a polyethylene bag.**
- **Never autoclave the respiration pickup.**
- **The sterilizing temperature must not exceed 65°C (149°F) because the respiration pickup may deform or melt above this temperature.**

NOTE

Do not let any liquid contact the connector.

Wipe the respiration pickup with a soft cloth moistened with water and neutral detergent or disinfecting alcohol.

SpO_2

NOTE

For details, refer to the probe manual.

Expiration of Probes

CAUTION

- **Do not use the probe over its stated lifetime. Otherwise the SpO_2 measurement accuracy cannot be guaranteed.**
- **Do not use disposable probes for other patients. If the probe is dirty with blood or bodily fluids, replace it with a new one.**

- **Reusable Probes**

  Do not use the probe for more than one year after opening the package. If the hours are recorded, you can use the probe for up to 6,000 hours. The date of manufacture is stamped on the probe connector. When the package is opened, write the date on the cable tag. Remove the backing and apply the film.

  Warranty for reusable probe

  Nihon Kohden Corporation (NKC) shall warrant this probe against all defects in materials and workmanship for a period of 6 months after package is opened. NKC or its authorized agents will repair or replace any probe which proves to be defective during the warranty period, provided the probe is used in accordance with the operator's manual.

- **Disposable Probes**

  Replace the probe with a new one every 32 hours when using a TL-251T/252T/253T disposable probe or every 96 hours (4 days) when using a TL-051S/052S/061S/062S disposable probe. Otherwise, accurate measurement cannot be continued. If the probe is dirty with blood or bodily fluids, replace the probe with a new one.

Disposing of Probes

Follow your local laws for disposing of medical waste.

Cleaning, Disinfecting and Sterilizing the TL-201T Finger Probe

Cleaning

CAUTION

- **Do not use creosol soap, glutaraldehyde, sodium hypochlorite, or benzalkonium chloride because they damage the probe.**
- **Clean the probe after every use. Otherwise the probe deteriorates.**

Wipe the probe and cable with a soft cloth or cotton swab moistened with 70% alcohol solution. Dry the probe and cable thoroughly.

Disinfecting

CAUTION

- **Do not wet the connector with disinfectants or water. If it gets wet, thoroughly wipe it. Do not use the probe with the connector wet.**
- **Do not use Hibitane alcohol for disinfection. It may deteriorate the resin.**
- **Bodily fluids and disinfectants remaining in the probe will deteriorate the rubber part of the probe. Replace the probe with a new one if it gets deteriorated.**

To disinfect the probe, soak the probe in either of the disinfectants below. For the procedure, refer to the disinfectant manual. Use the recommended concentration.

- Glutaraldehyde solution 2.0%
- Hydrochloric alkyldiaminoethylglycine 0.5%

After disinfection, wash the probe with running water. Push the rubber part of the probe to remove liquid inside the rubber part of the probe. Dry the probe thoroughly.

NOTE

After disinfection, the light emitter and the window of the light receiver may be colored. It does not affect the measurement.

Sterilizing

CAUTION

Do not autoclave the probe. It will damage the probe.

If necessary, sterilize the probe with ethylene oxide gas. The sterilizing conditions depend on the contamination of the probe. Refer to the manual of the sterilizing equipment. The following is an example.

Gas:	EO 30% + CO_2 70%	Relative humidity:	50%
EO concentration:	710 mg/L	Pressure:	49 kPa (0.5 kg/cm^2)
Temperature:	45°C, 113°F	Period:	4 to 10 hours

To remove the remaining gas from the probe after sterilization, first decrease the internal pressure of the sterilization equipment to –760 mmHg with a vacuum pump, then add carbon dioxide or antiseptic gas in the equipment. Repeat this procedure at least 5 times. Take the probe out of the sterilization equipment and do not use it for at least 20 days.

Sterilizing the Disposable Probe

CAUTION

- **Never autoclave the probe.**
- **The sterilizer temperature must not exceed 70°C (158°F) because the probe may deform or melt above this temperature.**
- **Do not use disposable probes for other patient. If the probe is dirty with blood or bodily fluids, replace it with a new one.**
- **Do not soak the probe in cleaning solution because it is not waterproof.**
- **Do not use any disinfecting alcohol. It may damage the probe.**

The disposable probes are not sterilized. If necessary, sterilize the probe with ethylene oxide gas. These probes can be sterilized only once before use. The sterilizing conditions depend on the contamination of the probe. Refer to the manual of the sterilizing equipment. The following is an example.

Gas:	EO 30% + CO_2 70%	Relative humidity:	50%
EO concentration:	710 mg/L	Pressure:	49 kPa (0.5 kg/cm^2)
Temperature:	45°C, 113°F	Period:	4 to 10 hours

To remove the remaining gas from the probe after sterilization, first decrease the internal pressure of the sterilization equipment to –760 mmHg with a vacuum pump, then add carbon dioxide or antiseptic gas in the equipment. Repeat this procedure at least 5 times. Take the probe out of the sterilization equipment and do not use it for at least 3 days.

After using EOG, ventilate the air thoroughly.

Cleaning and Disinfecting the SpO_2 Connection Cord

NOTE

- **Do not touch the connector pins.**
- **Do not wet the connector.**

Cleaning

Wipe the SpO_2 connection cord with a soft cloth moistened with neutral soap, water or alcohol and wipe with a dry cloth or gauze.

Disinfecting

To disinfect the SpO_2 connection cord, wipe it with a non-abrasive cloth moistened with any of the disinfectants listed below. Use the recommended concentration.

Disinfectant	Concentration (%)
Chlorohexidine gluconate solution	0.5
Benzethonium chloride solution	0.2
Glutaraldehyde solution	2.0
Benzalkonium chloride	0.2
Hydrochloric alkyldiaminoethylglycine	0.5

NIBP

CAUTION

- **Follow the instruction manual of the cuffs and hoses.**
- **Do not wet the connector.**
- **For Nihon Kohden cuffs and hoses, the sterilizer temperature must not exceed 65°C (149°F) because the cuff or hose may deform or melt above this temperature.**

NIBP Cuff Lifetime

Replace the NIBP cuff one year after you start using it. The lifetime of the rubber cuff is approximately 30,000 inflations.

Cleaning and Disinfecting the YP-950T/951T/952T/953T/954T/955T/960T/961T/962T/963T/964T/965T Reusable Cuffs

CAUTION

- **Do not autoclave.**
- **Use only glutaraldehyde solution.**
- **Never allow liquid to get inside the rubber cuff.**
- **Do not sterilize or disinfect the cuff with ultraviolet light or ozone.**

To clean the cuff, carefully pull out the rubber cuff from the cloth cover.
Cloth cover: Wash with neutral detergent and water. Thoroughly dry it.
Rubber cuff: Wipe with a soft cloth or cotton moistened with disinfecting alcohol. Thoroughly dry it.

To disinfect the cuff, use glutaraldehyde solution. Use the disinfectant of the recommended concentration. Refer to the disinfectant manual for details. After disinfection, clean the cuff as described above.

Cleaning and Disinfecting the YP-900P/901P/902P/903P/904P/905P/906P Reusable Cuffs

CAUTION

- **Do not soak the reusable cuff in chemical solutions or water. Otherwise water gets into the cuff and correct measurement data cannot be obtained.**
- **Never use any heat sterilization (disinfection) such as disinfection by boiled water, autoclave sterilization, or hot-air sterilization. It may damage the cuff.**
- **Do not use hydrogen peroxide disinfectants such as saponated cresol solution, glutaraldehyde solution, sodium hypochlorite, and benzethonium chloride solution. It may damage the reusable cuff.**

Wipe the cuff with cotton wool or a soft cloth moistened with 70% isopropyl alcohol.

Cleaning and Disinfecting the Air Hose and Extension Hose

CAUTION

Do not soak the tip of the hose in water. Otherwise, water gets into the hose and correct measurement data cannot be obtained.

NOTE

Do not let any liquid contact the connector.

To clean the hoses, wipe them with a soft cloth moistened with neutral detergent and approx. 40°C (104°F) warm water.

To disinfect the hoses, wipe them with a soft cloth moistened with either of the disinfectants listed below. Follow the disinfectant instruction and use the recommended concentration.

Disinfectant
Chlorohexidine gluconate solution
Hydrochloric alkyldiaminoethylglycine

Disinfecting the Disposable Cuffs

CAUTION

- **For Nihon Kohden cuffs and hoses, the sterilizer temperature must not exceed 65°C (149°F) because the cuff or hose may deform or melt above this temperature.**
- **Do not sterilize or disinfect the non-sterilized disposable cuffs for neonates.**
- **Do not reuse disposable cuffs.**

To disinfect disposable cuffs before use, refer to “Disinfecting Disposable Cuffs before Use” in Section 14.

The disposable cuffs for adults, children and infants can be sterilized. To sterilize these cuffs, use glutaraldehyde solution by following its instructions.

Disposal of Disposable Cuffs

Follow your local laws for disposing of medical waste.

IBP

The procedure described in this section is a typical maintenance procedure.

For details, refer to the instruction manual for each part.

Cleaning, Disinfecting, Sterilizing and Storing the Blood Pressure Transducer

CAUTION

- **Never put a pressure transducer in a steam autoclave, because moisture will damage the internal mechanism.**
- **When the dome is removed from the transducer, do not apply force to the exposed sensing diaphragm.**
- **Do not scrape or scrub the diaphragm to remove blood.**
- **When immersing the transducer in a sterilizing solution with other instruments or when storing the transducer after use, protect the transducer diaphragm with a dome or protective cap.**
- **Do not re-use a disposable transducer.**

When using a dome without a membrane, disinfect and sterilize according to the following procedure.

Cleaning the Blood Pressure Transducer

Wash the blood pressure transducer and dome separately with water.

NOTE

- **Do not wet the connector of the blood pressure transducer.**
- **When removing the dome from the blood pressure transducer, be careful not to touch the diaphragm.**

Disinfecting and Storing the Blood Pressure Transducer

CAUTION

- **Check the cables before soaking them in solution. If the cable sheath is damaged, the solution will soak into the cable and transducer and cause transducer corrosion and decrease the isolation.**
- **Do not wet the connector at the end of the transducer cable when washing the transducer.**
- **When immersing with other devices in the chemical solution, attach the dome or cap to the blood pressure transducer to protect the diaphragm.**
- **Do not soak the transducer with dome in the disinfectant.**

1. Wash the transducer and dome with water and soak in any of the following chemical solutions.

Type	Main ingredient	Dilution	Dipping time	Post-treatment
For surgical instruments	Detergicide®	750 times	30 minutes or more	Soak in 4000 times diluted solution
	Benzalkonium Chloride	100 times	10 minutes	Dry after washing
	Benzethonium Chloride	100 times	10 minutes	Dry after washing
For clinical instruments	Glutaraldehyde (Sterihyde®)	2W/V%	1 hour or more	Dry after washing
	Glutaraldehyde (Cidex®)	2.25W/V%	1 hour or more	Dry after washing

2. After disinfecting, rinse the transducer and dome thoroughly with sterilized water, and wipe off with a clean dry gauze.

3. Loosely attach the dome to the transducer.

CAUTION

Tightening the dome to the transducer can damage the dome.

4. Wrap the transducer with a 20 cm square clean gauze loosely, and wrap it again with sterilized cloth.

5. Loosely wind the cord around the sterilized cloth.

6. Store in a dry and clean place.

NOTE

To protect the diaphragm, store with the dome or cap attached.

Sterilizing and Storing the Blood Pressure Transducer

CAUTION

- **Do not sterilize the transducer by boiling, heating, or autoclaving.**
- **The sterilizing temperature must not exceed 65°C (149°F). Otherwise the transducer may deform above this temperature.**
- **Do not touch the diaphragm when removing the dome from the transducer.**
- **Do not rub the diaphragm to remove blood.**

1. Cover the cleaned and dried transducer connector with a polyethylene bag and tie with a rubber band.

2. Loosely secure the dome on the transducer and wind the cord in a large circle and place it inside the EOG sterilization bag.

CAUTION

- **The dome may be damaged by sterilization if clamped too tight.**
- **Do not bend the cords. Make as large a loop of cord as possible for easy ventilation of air from inside the transducer and protection from damage which may be caused by rapid pressure changes during gas sterilization.**

3. Sterilize the transducer and dome with ethylene oxide gas (EOG).

4. Remove the gas from the EOG sterilization bag and store the blood pressure transducer in the EOG sterilization bag in an appropriate place.

NOTE

To protect the diaphragm, store with the dome or cap attached.

5. After using EOG, ventilate the air thoroughly.

Disposing of Transducer and Dome

Follow your local laws for disposing of medical waste.

Cleaning and Disinfecting the IBP Connection Cord

CAUTION

- **Do not immerse the connector in any liquid, because this may damage the connector wiring and the liquid may get inside the connector.**
- **A break in the plastic covering may cause the solution to get inside the cable, and damage the transducer.**
- **The IBP connection cord connector has a memory chip. Do not let any liquid contact the connector and do not touch the connector pins.**

To clean the IBP connection cord, wipe it with a soft cloth moistened with neutral detergent and approx. 40°C (104°F) warm water.

To disinfect the IBP connection cord, wipe it with a soft cloth moistened with any of the disinfectants listed below. Use the recommended concentration.

Disinfectant	Concentration (%)
Chlorohexidine gluconate solution	0.5
Benzethonium chloride solution	0.2
Glutaraldehyde solution	2.0
Benzalkonium chloride	0.2
Hydrochloric alkyldiaminoethylglycine	0.5

Temperature

Cleaning, Disinfecting and Sterilizing the Reusable Probe

NOTE

Refer to the probe instruction manual for details on maintenance.

Disposal of Disposable Probe

Follow your local laws for disposing of medical waste.

Cleaning and Disinfecting the Temperature Connection Cord

NOTE

- **Do not touch the connector pins.**
- **Do not wet the connector.**

Cleaning

Wipe the temperature connection cord with a soft cloth moistened with neutral soap, water or alcohol and wipe with a dry cloth or gauze.

Disinfecting

To disinfect the temperature connection cord, wipe it with a non-abrasive cloth moistened with any of the disinfectants listed below. Use the recommended concentration.

Disinfectant	Concentration (%)
Chlorohexidine gluconate solution	0.5
Benzethonium chloride solution	0.2
Glutaraldehyde solution	2.0
Benzalkonium chloride	0.2
Hydrochloric alkyldiaminoethylglycine	0.5

CO

Cleaning and Disinfecting the Catheter and Measuring System

NOTE

For details on maintenance, refer to the instruction manuals of the catheter and measuring system.

Cleaning and Disinfecting the CO Connection Cord

NOTE

- **Do not touch the connector pins.**
- **Do not wet the connector.**

Cleaning the CO Connection Cord

Wipe the CO connection cord with a non-abrasive cloth which has been moistened with neutral detergent and approx. 40°C (104°F) warm water.

Disinfecting the CO Connection Cord

CAUTION

- **Never autoclave the CO connection cord.**
- **Do not soak the CO connection cord in alcohol. It may harden and deteriorate it.**

To disinfect the CO connection cord, wipe it with a non-abrasive cloth moistened with any of the disinfectants listed below. Use the recommended concentration.

Disinfectant	Concentration (%)
Chlorohexidine gluconate solution	0.5
Benzethonium chloride solution	0.2
Glutaraldehyde solution	2.0
Benzalkonium chloride	0.2
Hydrochloric alkyldiaminoethylglycine	0.5

Disposing of Catheter

Follow your local laws for disposing of medical waste.

CO_2

Expiration and Replacement of the Airway Adapter

CAUTION

- **The airway adapter is non-sterilized and disposable. Use only for single patient and single use. Failure to follow this instruction causes cross infection.**
- **Failure to follow the following instructions degrades the anti-fogging ability of the transparent film and results in incorrect measurements.**
  - **Replace the airway adapter with a new one every 24 hours.**
  - **Replace the airway adapter with a new one if blood, sputum or mucus adhere to the transparent film.**
  - **Do not damage the transparent film. Do not let dust or detergent contact the transparent film. Do not touch, wipe or clean the transparent film with fingers or any cleaners.**
- **Do not sterilize the airway adapter more than once. The safety cannot be guaranteed.**
- **Do not autoclave the airway adapter. High temperature and high pressure damages the adapter.**

When the transparent film of the airway adapter becomes dirty, replace the airway adapter with a new one instead of cleaning it. Attempting to remove the stain or washing with a cleaner damages the transparent film and makes correct measurement impossible.

To remove stains at areas other than the transparent film, wipe with a cotton swab moistened with alcohol.

Disposing of the Airway Adapter

Follow your local laws for disposing of medical waste.

Replacing the CO_2 Sensor and Adapter of the CO_2 Sensor Kit

CAUTION

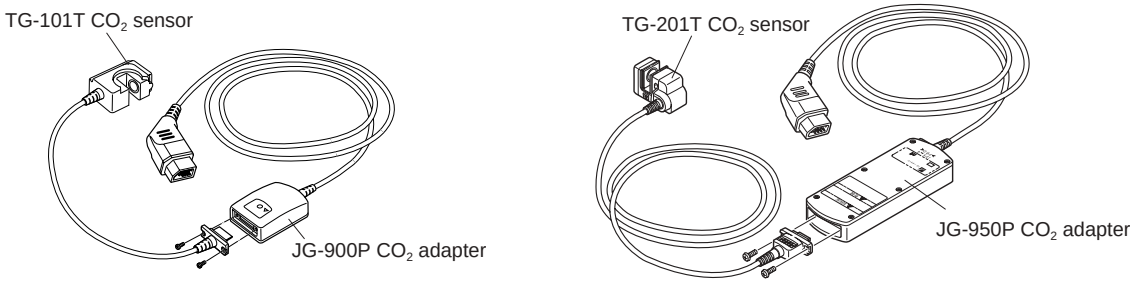
When the "CHANGE ADAPTER" or "CHANGE SENSOR" message is displayed, check the CO_2 sensor kit. CO_2 cannot be monitored while the message is displayed.

NOTE

- **Replacement should be done by a Nihon Kohden distributor or personnel with electrical knowledge.**
- **After removing the new CO_2 sensor from its bag, handle it carefully**

because static electricity, water or chemical solutions damage the CO_2 sensor.

The CO_2 sensor and CO_2 adapter of the CO_2 sensor kit can be replaced separately. When either one malfunctions or when it is time to replace them, remove the screws and replace it with a new one.



Cleaning and Disinfecting the CO_2 Sensor

CAUTION

- **Do not use corrosive solutions and solutions with polishing agents. Do not clean the sensor with steel wool and sharp objects because it scratches the CO_2 sensor and disables correct measurements.**
- **Never sterilize the CO_2 sensor by autoclaving because the CO_2 sensor will be damaged.**

After using the CO_2 sensor, clean and disinfect it.
Clean the lamp and detector of the CO_2 sensor with a cotton swab moistened with ethanol and leave it to dry.

Cleaning and Disinfecting the CO_2 Sensor Cable

CAUTION

The CO_2 sensor cable connector has a memory chip. Do not let any liquid contact the connector and do not touch the connector pins.

Cleaning

Wipe the CO_2 sensor cable with a soft cloth moistened with neutral soap, water or alcohol and wipe with a dry cloth or gauze.

Disinfecting

To disinfect the CO_2 sensor cable, wipe it with a non-abrasive cloth moistened with any of the disinfectants listed below. Use the recommended concentration.

Disinfectant	Concentration (%)
Chlorohexidine gluconate solution	0.5
Benzethonium chloride solution	0.2
Glutaraldehyde solution	2.0
Benzalkonium chloride	0.2
Hydrochloric alkyldiaminoethylglycine	0.5

FiO_2

Lifetime and Replacement of Oxygen Sensor

The life span of the oxygen sensor is about 1 to 5 years. It will be shorter when used in places with high oxygen concentration, and longer in places with low oxygen concentration.

When the "CAL??" message is displayed on the screen, check the connection of the oxygen sensor, and if the problem still occurs, replace the oxygen sensor with a new one.

Cleaning, Disinfecting and Sterilizing the Oxygen Sensor

CAUTION

- **Never boil or autoclave the oxygen sensor.**
- **The sterilizer temperature must not exceed 65°C (149°F) because the oxygen sensor may deform or melt above this temperature.**

Wipe with a soft cloth moistened with water and neutral detergent or disinfecting alcohol.

To sterilize, use the ethylene oxide gas (EOG). Refer to the instructions for using EOG.

After using EOG, ventilate the air thoroughly.

Storing the Oxygen Sensor

When not performing measurements, disconnect the oxygen sensor from the inspiration circuit and FiO_2 connection cord, and store it in a place where it will not be exposed to high oxygen concentration over a long period of time. Store the oxygen sensor with its detector horizontal or facing down.

CAUTION

When storing the oxygen sensor, face the detector down. Otherwise, the detector gets dried. When the detector is completely dry, the oxygen sensor must be left with the detector facing down for more than 12 hours before FiO_2 monitoring.

Disposal of the Oxygen Sensor

The oxygen sensor is composed of an oxygen lead battery. Before disposing of the battery, check with your local solid waste officials for details in your area for proper disposal. It may be illegal to dispose of this battery into the municipal waste stream.

Cleaning, Disinfecting and Sterilizing the T-shaped Adapter

Wipe the T-shaped adapter with a non-abrasive cloth moistened with disinfecting alcohol.

To sterilize the T-shaped adapter, use EOG or autoclave.

Refer to the instructions for using EOG. After using EOG, ventilate the air thoroughly.

When autoclaving, autoclave the T-shaped adapter at 126°C (259°F) for 15 minutes.

Cleaning and Disinfecting the FiO_2 Connection Cord

NOTE

- **Do not touch the connector pins.**
- **Do not wet the connector.**

Cleaning

Wipe the FiO_2 connection cord with a non-abrasive cloth which has been moistened with neutral detergent and approx. 40°C (104°F) warm water.

Disinfecting

To disinfect the FiO_2 connection cord, wipe it with a non-abrasive cloth moistened with any of the disinfectants listed below. Use the recommended concentration.

Disinfectants	Concentration (%)
Chlorohexidine gluconate solution	0.5
Benzethonium chloride solution	0.2
Glutaraldehyde solution	2.0
Benzalkonium chloride	0.2
Hydrochloric alkyldiaminoethylglycine	0.5

Cleaning and Disinfecting the Monitor

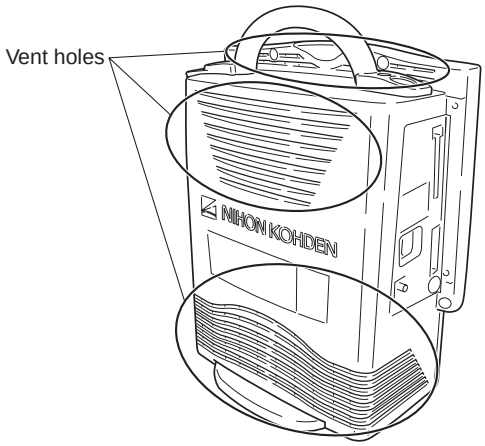
CAUTION

- **Do not use volatile liquids such as thinner or benzine, because these will cause the materials to melt or crack.**
- **Before cleaning the monitor, turn the monitor power off and disconnect the power cord from the AC SOURCE power cord socket on the left side panel.**
- **After cleaning, make sure that the monitor is completely dried.**
- **Wipe the monitor thoroughly after disinfecting it with spray.**
- **The monitor is not waterproof. Be careful not to let any water get inside the monitor.**
- **Never sterilize the monitor because the materials may deform, crack or discolor.**

Cleaning

Clean the surface of the monitor every month with a soft cloth moistened with neutral soap, water or alcohol (76.9 to 81.4%), and wipe with a dry cloth or gauze.

Remove dust from the vent holes on the panels with a cotton swab.



Disinfecting

To disinfect the outside surface of the monitor, wipe it with a non-abrasive cloth moistened with any of the disinfectants listed below. Use the recommended concentration.

Disinfectant	Concentration (%)
Chlorohexidine gluconate solution	0.5
Benzethonium chloride solution	0.2
Glutaraldehyde solution	2.0
Benzalkonium chloride	0.2
Hydrochloric alkyldiaminoethylglycine	0.5

Cleaning the Recorder

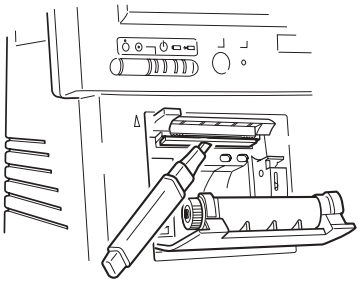
CAUTION

- **Do not touch the head with any hard object. When the head is tapped with a hard object, the head may crack and the heater element wire may break.**
- **Clean the head surface with the provided head cleaner pen before loading new paper. After a period of usage, paper dust may come between the paper and the head surface and good printing cannot be obtained.**
- **Be careful not to cut yourself with the paper cutter on the recorder.**

Cleaning the Thermal Head

To protect the thermal head from abrasion or damage and assure optimum performance and long service life, clean the surface of the head with the provided thermal head cleaning pen after every 7 to 10 sets of recording paper.

1. Turn off the monitor before cleaning the thermal head.

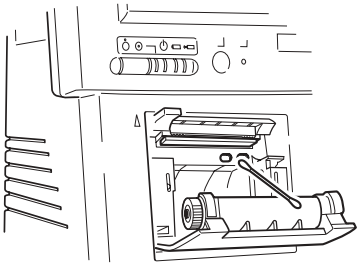


2. Push up the paper magazine release lever and open the paper magazine.

3. Clean the gold-colored part of the thermal head with the thermal head cleaning pen.

Cleaning the Sensors

The paper empty sensor and mark sensors are located as shown at the left.



Clean the sensor surfaces with a cotton swab.

Yearly Inspection

Check the following items every year to keep your monitor in optimal condition.

- Monitor is not dirty, damaged or rusty.
- No key, switch or dial is broken.
- Power cord is not damaged.
- Grounding lead is properly connected.
- Screen is clean.
- Screen brightness can be adjusted.
- Screen display is correct.
- Clock on the screen is correct.
- SYSTEM SETUP settings are correct.
- The specified electrodes, sensors, transducers and probes are used.
- Recorder operates properly (on BSM-4101/4102/4103/4104 monitors only).
- The specified recording paper is used.
- The printed date is correct.
- Alarm setting is correct and functions properly.
- Alarm indicator lamps light.
- The sync sound is produced and sync mark is displayed.
- The blood pressure zero balance is performed.
- The blood pressure label is attached to the connection cord connector.
- The correct values are obtained for invasive blood pressure, CO_2 and FiO_2 in the calibration by the specified mercury manometer and calibration gas.
- No current leakage.
- Supplied voltage is correct.
- Measurement accuracy is within the specified range.
- No damage to the sockets on the monitor.
- Only the specified parts are used.

Clock Accuracy

At an operating temperature of 25°C, the accuracy of the clock IC of this monitor is about ±2 min 40 s per month.

At the storage temperature of between –20 and 60°C, the accuracy of the clock IC of this monitor is about ±5 min per month.

Periodically check that the time in the upper right corner of the monitor screen is correct.

To change the time setting, refer to “Changing Date and Time” in Section 4.

NOTE

When the date or time is changed during monitoring, the date and time of all stored data is also changed and may not match the date and time on the printout.

When the monitor is connected to a network

The time on this monitor is automatically adjusted to match the time of the network as long as the monitor is connected to the network. The date and time on all monitors in the network are set to the same setting.

Periodical Replacement Schedule

To maintain the performance of the instrument, the following part must be periodically replaced.

Description	Expected Life Span
Backlight assembly for LCD unit	Approx. 25000 hours or 2 years and 10 months of continuous operation
Thermal array head for recorder unit	Approx. 250 stacks of the recording paper
Paper drive motor for recorder unit	Approx. 6000 stacks of the recording paper

Repair Parts Availability Policy

Nihon Kohden Corporation (NKC) shall stock repair parts (parts necessary to maintain the performance of the instrument) for a period of 8 years from the date of delivery. In that period NKC or its authorized agents will repair the instrument. This period may be shorter than 8 years if the board or part necessary for the faulty section is not available.

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Factory Default Settings

This section shows the available settings. The factory default settings are underlined.

OK: Remains in memory even when the power is turned off.
30 min: Remains in memory for at least 30 minutes after turning power off. After 30 minutes, the setting changes back to the default setting.
--: Returns to the default setting when the power is turned off.

For the alarm settings, refer to the “VITAL ALARM Window” and “ARRHYTH ALARM Window” sections.

SYSTEM SETUP Screen

Refer to “List and Explanation of the SYSTEM SETUP Settings” in Section 3.

ECG Window

Items			Setting Items	Default Setting	Backup
SENSITIVITY			×1/4, ×1/2, AUTO, ×1, ×2, ×4	×1	OK
LEAD			I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6	II	
OTHER SETTING	NUMBER OF ELECTRODES		3, 6, 10	3	
	SYNC SOURCE		ECG, SpO_2, P1	ECG	
	HR DISPLAY MODE		AVERAGE ECG, INSTANT ECG	AVERAGE ECG	
	ARRHYTHMIA ANALYSIS		ON, OFF	ON	
	PACING	DETECTION	ON, OFF	OR, ICU: ON NICU: OFF	
		MARK	ON, OFF	OFF	
	FILTERS		MAXIMUM, MONITOR, DIAG	OR, NICU: MAXIMUM ICU: MONITOR	
	AUTO LEAD CHANGE		ON, OFF	OFF	
FREE LEAD	FREE LEAD a (Ca/Va)		V1, V2, V3, V4, V5, V6	V4	
	FREE LEAD b (Cb/Vb)		V1, V2, V3, V4, V5, V6	V5	

RESP Window

Items		Setting Items	Default Setting	Backup
IMP RESP LEAD		R-L, R-F	R-F	OK
SENSITIVITY		×1/4, ×1/2, ×1, ×2, ×4	×1	
OTHER SETTING	IMP RESP MEASURE	ON, OFF	OR: OFF ICU, NICU: ON	
	RESP/CO2 SWEEP SPEED	1 mm/s, 6 mm/s, 25 or 50 mm/s	OR: 6 ICU: 25 or 50 NICU: 1	

SpO_2 Window

Items		Setting Items	Default Setting	Backup
SENSITIVITY		×1/8, ×1/4, ×1/2, AUTO, ×1, ×2, ×4, ×8	AUTO	OK
OTHER SETTING	SYNC SOURCE	ECG, SpO2, P1	ECG	
	SYNC PITCH	FIXED, SpO2, P1	FIXED	
	RESPONSE*	FAST, NORMAL, SLOW	NORMAL	
	RESPONSE**	FAST, NORMAL	NORMAL	

* Only available on the BSM-4101/4103/4111/4113 monitors.

* Only available on the BSM-4102/4104/4112/4114 monitors with a "Nellcor OxiMax™" label on the socket panel.

NIBP Window

Items			Setting Items	Default Setting	Backup
MEASURE INTERVAL*			MANUAL, STAT, 2 min, 2.5 min, 5 min, 10 min, 15 min, 30 min, 1 hour, 2 hour, 4 hour, 8 hour	MANUAL	30 min
HARD KEY INTERVALS			MANUAL, STAT, 2 min, 2.5 min, 5 min, 10 min, 15 min, 30 min, 1 hour, 2 hour, 4 hour, 8 hour	OR: STAT, 2.5, 5, 10 min ICU: 5, 10, 30 min, 1 h NICU: 30 min, 1 h	OK
PWTT	PWTT		ON, OFF	OFF	OK
	TRIGGER TIME		5 to 30 ms	15 ms	
OTHER SETTING	TARGET CUFF PRESSURE	Adult/Child	100 to 280 mmHg	180 mmHg	**
			13.0 to 37.0 kPa	24.0 kPa	
		Neonate	70 to 120 mmHg	100 mmHg	
			9.0 to 16.9 kPa	13.0 kPa	

* Only available on the BSM-4101/4103/4111/4113 monitors.

PRESS Window

Items		Setting Items	Default Setting	Backup
P1 SCALE, P2 SCALE, P3 SCALE		0-20, 0-50, 0-100, 0-160, 0-200, 0-300 mmHg	P1 SCALE OR, ICU: 0-200 NICU: 0-100 P2, P3 SCALE 0-100	OK
		0-2.7, 0-6.7, 0-13.3, 0-21.3, 0-26.7, 0-40.0 kPa	P1 SCALE OR, ICU: 0-26.7 NICU: 0-13.3 P2, P3 SCALE 0-13.3	
LABEL		ART, ART-2, RAD, DORS, AO, FEM, UA, UV, PAP, CVP, RAP, RVP, PRESS, PRESS-2, PRESS-3, ICP, ICP-2, ICP-3	---	--
OTHER SETTING	SYNC SOURCE	ECG, SpO_2, P1	ECG	OK
	SYNC PITCH	FIXED, SpO_2, P1	FIXED	
	CALCULATION METHOD	STANDARD, PEAK	STANDARD	
	PRESS SCALE	SEPARATE, COMMON	COMMON	
	NUMERIC DISPLAY	S/D(M), M	S/D(M)	

TEMP Window

Items	Setting Items	Default Setting	Backup
TEMPERATURE SETTING	T1&T2, T1&delta T	T1&T2	OK
LABEL	Tskin, Tskin-2, Trect, Tcore, Tnaso, Teso, Ttymp, Tblad, Taxil, Temp, Temp-2	---	--

CO_2 Window

Items		Setting Items	Default Setting	Backup
SCALE		0-20, 0-40, 0-80 mmHg	0-40	OK
		0-2.7, 0-5.3, 0-10.7 kPa	0-5.3	
GAS	GAS COMPOSITION	AIR, O_2+AIR, O_2+N_2O O_2: 0 to 100%, N_2O: 0 to 100%	O_2+AIR, O_2: 21, N_2O: 79	
OTHER SETTING	RESP/CO2 SWEEP SPEED	1 mm/s, 6 mm/s, 25 or 50 mm/s	OR: 6 ICU: 25 or 50 NICU: 1	

TREND Window

Items		Setting Items	Default Setting	Backup
24 h TREND		HR (fixed), PR, VPC, ST, RR, APNEA (F), APNEA (T), SpO2, NIBP, P1, P2, P3, T1&T2, CO2, FiO2, EVENT, CNIBP	HR	OK
Single trend time interval		1 hour, 2 hour, 4 hour, 8 hour, 24 hour	8	
SINGLE TREND		HR (fixed), PR, VPC, ST, RR, APNEA (F), APNEA (T), SpO2, NIBP, P1, P2, P3, T1&T2, CO2, FiO2, EVENT, CNIBP	HR	
SINGLE TREND SCALE	HR/PR (beats/min)	0-100, 0-200, 0-300	OR, ICU: 0-100 NICU: 0-200	
	VPC (VPCs/min)	0-20, 0-50, 0-100, 0-300	0-20	
	ST (mV)	±0.2, ±0.5, ±1.0, ±2.0	±0.5	
	ST (mm)	±2.0, ±5.0, ±10.0, ±20.0	±5.0	
	RR (breaths/min)	0-50, 0-150	OR, ICU: 0-50 NICU: 0-150	
	APNEA (F) (counts/min)	0-6, 0-12	0-6	
	APNEA (T) (s)	0-60, 0-120, 0-180	0-120	
	SpO_2 (%)	0-100, 50-100, 80-100	80-100	
	NIBP (mmHg)	0-100, 0-200, 0-300	OR, ICU: 0-200 NICU: 0-100	
	NIBP (kPa)	0-13.3, 0-26.7, 0-40.0	OR, ICU: 0-26.7 NICU: 0-13.3	
	P1, P2, P3 (mmHg)	0-20, 0-50, 0-100, 0-160, 0-200, 0-300	OR, ICU: P1 0-200 P2, P3 0-100 NICU: P1 0-200 P2, P3 0-100	
	P1, P2, P3 (kPa)	0-2.7, 0-6.7, 0-13.3, 0-21.3, 0-26.7, 0-40.0	OR, ICU: P1, P2, P3 0-26.7 NICU: P1 0-13.3 P2, P3 0-26.7	
	T1&T2 (°C)	34-40, 0-40, 20-40	34-40	
	T1&T2 (°F)	92-104, 20-120, 80-120	92-104	
	CO_2 (mmHg)	0-20, 0-40, 0-80	0-40	
	CO_2 (kPa)	0-2.7, 0-5.3, 0-10.7	0-5.3	
	FiO_2 (%)	30-60, 0-60, 0-100	30-60	
	EVENT	—		
APNEA INTERVAL (s)		5, 10, 15, 20, 25, 30, 35, 40	20	

The data on the TREND window remain in memory for 30 minutes after turning the power off. After 30 minutes, the data is lost.

LIST Window

Items	Setting Items	Default Setting	Backup
PERIODIC LIST INTERVAL	1, 5, 15, 30, 60 min	5	OK
LIST PARAMETERS	HR, PR, VPC, ST, RR, SpO_2, P1, P2, P3, NIBP*, T1 & T2, CO_2, FiO_2, CNIBP	HR, PR, VPC, RR, SpO_2, NIBP	

The data on the LIST screen remain in memory for 30 minutes after turning the power off. After 30 minutes, the data is lost.

* NIBP data is only listed on the NIBP list screen. Refer to “LIST Window” in Section 7.

ARRHYTH RECALL Window

Items	Setting Items	Default Setting	Backup
ARRHYTHMIA ITEMS	ASYSTOLE, VF, VT, VPC RUN, COUPLET, EARLY VPC, BIGEMINY, VPC, BRADYCARDIA, TACHYCARDIA	ASYSTOLE, VF, VT, VPC RUN	30 min

The data on the ARRHYTH RECALL window remain in memory for 30 minutes after turning the power off. After 30 minutes, the data is lost.
The settings remain in memory for 30 minutes after turning the power off. After 30 minutes, the settings return to the arrhythmia recall master settings on the SYSTEM SETUP screen.

ST Window

Items		Setting Items	Default Setting	Backup
SETTING	ISO POINT	4 to 120 ms,	80	OK
	ST POINT	4 to 160 ms,	108	
ST DISPLAY	ST INTERVAL	1, 5, 15, 30, 60 min	5	

The data on the ST window remain in memory for 30 minutes after turning the power off. After 30 minutes, the data is lost.

CO Window

Items			Setting Items	Default Setting	Backup
SETTING	CATH SET	MANUFACTURER	Baxter, B.D	Baxter	OK
		Catheter type	BATH PROBE, INLINE SENSOR	BATH PROBE	
		Catheter size	5F, 5.5F, 6F, 7F, 7.5F, 8F	7.5	
		Injectate volume	3 cc, 5 cc, 10 cc	10	
		CONSTANT	0 to 1.000	0.564	

INTERBED Window

Items		Setting Items	Default Setting	Backup
SETTING	INTERBED ALARM	ON, OFF	OFF	OK
	AUTO INTERBED DISPLAY	ON, OFF	OFF	

RECORDING Window

Items		Setting Items	Default Setting	Backup
RECORDING	ALARM RECORDING	ON, OFF	ON	OK
	PERIODIC REC INTERVAL (min)	OFF, FREE, 30, 60, 120	OFF	
	RECORDING SWEEP SPEED	25 mm/s, 50 mm/s	25 mm/s	
	SECOND WAVE	RESP, SpO_2, CO_2, P1, P2, P3, OFF	OFF	
PRINTER	FULL DISCLOSURE	20 min, 1, 2, 4, 8, 24 hours, ALL	20 min	

VITAL ALARM Window

Items	Setting Items	Default Setting	Backup
HR/PR (beats/min)	Upper: 20 to 300, OFF (5 steps) Lower: 15 to 295, OFF (5 steps)	Upper OR, ICU: 140 NICU: 180 Lower OR, ICU: 40 NICU: 80	30 min
RR (breaths/min)	Upper: 2 to 150, OFF (2 steps) Lower: 0 to 148, OFF (2 steps)	Upper: OFF Lower: OFF	
APNEA (s)	5 to 40, OFF (5 steps)	20	
SpO2 (%)	Upper: 51 to 100, OFF (1 steps) Lower: 50 to 99, OFF (1 steps)	Upper: OFF Lower: 90	
EtCO2 (mmHg)	Upper: 2 to 99, OFF (1 steps) Lower: 1 to 98, OFF (1 steps)	Upper: OFF Lower: OFF	
EtCO2 (kPa)	Upper: 1.0 to 13.5, OFF (0.5 steps) Lower: 0.5 to 13.0, OFF (0.5 steps)	Upper: OFF Lower: OFF	
FiCO2 (mmHg)	Upper: 1 to 5, OFF (1 steps)	OR: 3 ICU, NICU: OFF	
FiCO2 (kPa)	Upper: 0.1 to 0.7, OFF (0.1 steps)	OR: 0.4 ICU, NICU: OFF	
FiO2 (%)	Upper: 19 to 100, OFF (1 steps) Lower: 18 to 99, OFF (1 steps)	Upper: OFF Lower: 18	
NIBP (mmHg)	Upper: 15 to 260, OFF (5 steps) Lower: 10 to 255, OFF (5 steps)	Upper: SYS: adult/child 180, neonate 100, DIAS: OFF, MEAN: OFF Lower: SYS: adult/child 80, neonate 40, DIAS: OFF, MEAN: OFF	
NIBP (kPa)	Upper: 1.5 to 35.0, OFF (0.5 steps) Lower: 1.0 to 34.5, OFF (0.5 steps)	Upper SYS: adult/child 24.0, neonate 13.5 DIAS: OFF, MEAN: OFF Lower SYS: adult/child 10.5, neonate 5.5 DIAS: OFF, MEAN: OFF	
ST (mV)	Upper: –1.99 to +2.00, OFF (0.01 steps) Lower: –2.00 to +1.99, OFF (0.01 steps)	Upper: +0.5 Lower: –0.5	
ST (mm)	Upper: –19.9 to +20.0, OFF (0.1 steps) Lower: –20.0 to +19.9, OFF (0.1 steps)	Upper: +5.0 Lower: –5.0	
P1, P2, P3 (mmHg)	Upper: 2 to 300, OFF (2 steps) Lower: 0 to 298, OFF (2 steps)	Upper SYS: OFF, DIAS: OFF, MEAN: OFF Lower P1 SYS OR, ICU: 80 NICU: 50 Lower DIAS: OFF Lower P1 MEAN OR, ICU: 60 NICU: 30 Others SYS: OFF, DIAS: OFF, MEAN: OFF	
P1, P2, P3 (kPa)	Upper: 0.5 to 40.0, OFF (0.5 steps) Lower: 0.0 to 39.5, OFF (0.5 steps)	Upper SYS: OFF, DIAS: OFF, MEAN: OFF Lower P1 SYS OR, ICU: 10.0 NICU: 6.0 Lower DIAS: OFF Lower P1 MEAN OR, ICU: 8.0 NICU: 4.0 Others SYS: OFF, DIAS: OFF, MEAN: OFF	
T1, T2, delta T (°C)	Upper: 0.1 to 45.0, OFF (0.1 steps) Lower: 0 to 44.9, OFF (0.1 steps)	Upper T1 OR, ICU: 38.0 NICU: 39.0 T2, deltaT: OFF Lower: OFF	
T1, T2, delta T (°F)	Upper: 33 to 113, OFF (1 steps) Lower: 32 to 112, OFF (1 steps)	Upper OR, ICU: 100 NICU: 102 T2, deltaT: OFF Lower: OFF	

The settings remain in memory for 30 minutes after turning the power off. After 30 minutes, the settings return to the vital alarm master settings on the SYSTEM SETUP screen.

ARRHYTH ALARM Window

Items	Setting Items	Default Setting	Backup
ASYSTOLE	ON (fixed), threshold 3 to 10 s	OR, ICU: threshold 5 NICU: threshold 3	30 min
VF	ON (fixed)	—	
VT	ON (fixed)	—	
VPC RUN	ON, OFF threshold 3 to 8 VPCs	OR, NICU: OFF ICU: ON threshold 3	
COUPLET	ON, OFF	OFF	
EARLY VPC	ON, OFF	OFF	
BIGEMINY	ON, OFF	OFF	
FREQ VPC	ON, OFF threshold 1 to 50 VPCs/min	OFF threshold 10	

The settings remain in memory for 30 minutes after turning the power off. After 30 minutes, the settings return to the arrhythmia alarm master settings on the SYSTEM SETUP screen.

DATE & TIME Window

Items	Settings	Backup
YEAR	2000 to 2099	OK
MONTH	1 to 12	
DAY	1 to 31	
HOUR	0 to 23	
MINUTE	0 to 59	

The date and time are backed up by a lithium battery. The battery life is about 10 years.

SOUND & BRIGHT Window

Items	Setting Items	Default Setting	Backup
SYNC SOUND	ON, OFF	OR, ICU: ON NICU: OFF	OK
SYNC SOUND VOLUME	16 steps	5	
ALARM SOUND VOLUME	16 steps	10	
SCREEN BRIGHTNESS	8 steps	5	

DISPLAY Window

Items	Setting Items	Default Setting	Backup
TREND ON MONITORING SCREEN	NORMAL, OCRG 1 cm/min, OCRG 3 cm/min, OFF	OR, ICU: NORMAL NICU: OCRG 1 cm/min	OK
PRESS SCALE	SEPARATE, COMMON	COMMON	
NUMERIC DISPLAY OVER ECG	ON, OFF	2	
RESP/CO2 SWEEP SPEED	1 mm/s, 6 mm/s, 25 or 50 mm/s	OR: 6 ICU: 25 or 50 NICU: 1	
SWEEP SPEED	25 mm/s, 50 mm/s	25	

FUNCTION KEY Window

Items	Setting Items	Default Setting	Backup
FUNCTION KEY 1	FREEZE, TOUCHKEY OFF, ALL ZERO, CAL, PRINT, MAIN MENU, HOME, SLEEP MODE, SUSPEND MONITORING, BYPASS, ENLARGED, ECG SCROLL, 12 LEAD, CO, INTERBED, EXTERNAL DEVICE, TREND, LIST, HEMO LIST, ARRHYTH RECALL, FULL DISC, ST, ALARM HISTORY	MAIN MENU	OK
FUNCTION KEY 2		OR: TREND ICU: SLEEP MODE NICU: FREEZE	
FUNCTION KEY 3		OR, ICU: ALL ZERO NICU: ENLARGE	

DRUG CALCULATE
Window

Items		Setting Items	Default Setting	Backup
AMINOPHYLLINE	Drug amount (mg)	0.01 to 2000	500	OK
	Base volume (mL)	1 to 1000	250	
	Dose (mg/hr)	0.01 to 500	0.50	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
BRETYLIUM	Drug amount (mg)	0.01 to 2000	1000	
	Base volume (mL)	1 to 1000	250	
	Dose (mg/min)	0.01 to 500	1.00	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
DOPAMINE	Drug amount (mg)	0.01 to 2000	800	
	Base volume (mL)	1 to 1000	500	
	Dose (mcg/kg/min)	0.01 to 500	2.00	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
DOBUTAMINE	Drug amount (mg)	0.01 to 2000	500	
	Base volume (mL)	1 to 1000	250	
	Dose (mcg/kg/min)	0.01 to 500	2.50	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
HEPARIN	Drug amount (units)	100 to 150000	25000	
	Base volume (mL)	1 to 1000	1000	
	Dose (units/hr)	10 to 15000	1000	
	Dose step	10, 50, 100, 500	50	
NITROGLYCERINE NITROPRUSSIDE	Drug amount (mg)	0.01 to 2000	50	
	Base volume (mL)	1 to 1000	250	
	Dose (mcg/kg/min)	0.01 to 500	0.50	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
EPINEPHRINE	Drug amount (mg)	0.01 to 2000	1	
	Base volume (mL)	1 to 1000	250	
	Dose (mcg/min)	0.01 to 500	1.00	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
LIDOCAINE PROCAINAMIDE	Drug amount (mg)	0.01 to 2000	2000	
	Base volume (mL)	1 to 1000	500	
	Dose (mg/min)	0.01 to 500	2.00	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
INSULIN	Drug amount (mg)	0.01 to 2000	100	
	Base volume (mL)	1 to 1000	500	
	Dose (mg/min)	0.01 to 500	1.00	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
LEVOPHED	Drug amount (mg)	0.01 to 2000	4	
	Base volume (mL)	1 to 1000	250	
	Dose (mcg/min)	0.01 to 500	2.00	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
ISOPROTERENOL	Drug amount (mg)	0.01 to 2000	1	
	Base volume (mL)	1 to 1000	250	
	Dose (mcg/min)	0.01 to 500	0.50	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
INOCOR	Drug amount (mg)	0.01 to 2000	500	
	Base volume (mL)	1 to 1000	500	
	Dose (mcg/kg/min)	0.01 to 500	5.00	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	
STREPTOKINASE	Drug amount (IU)	1000 to 1500000	1500000	
	Base volume (mL)	1 to 1000	50	
	Dose (IU/hr)	1000 to 1500000	30000	
	Dose step	5000, 10000, 50000	5000	
TPA	Drug amount (mg)	0.01 to 2000	100	
	Base volume (mL)	1 to 1000	100	
	Dose (mg/hr)	0.01 to 500	60.00	
	Dose step	0.01, 0.05, 0.10, 1.00, 10.00	0.10	

Specifications

Display

Display size:	12.1 inch, TFT type LCD
Waveform display mode:	Non-fade moving or non-fade fixed
Viewing area:	246 mm × 184.5 mm
Resolution:	800 × 600 dots
Maximum number of waveform trace:	13 traces (12 lead display)
Sweep speed:	25 mm/s, 50 mm/s (Respiration low speed: 1.56 mm/s, when AG-920R connected: 6.25 mm/s)
Sweep time:	7.4 s (at 25 mm/s sweep speed)
Waveform display color:	12
Numeric display color:	12
Waveform freeze:	Provided
Display waveforms:	ECG, respiration, IBP, SpO_2 pulse wave, CO_2 and CO thermodilution curve
Numerical data display:	Heart rate, VPC rate, ST level, respiration rate, IBP (systolic, diastolic, mean), NIBP (systolic, diastolic, mean), SpO_2, pulse rate, temperature, CO, FiO_2, $EtCO_2$, $FiCO_2$
Synchronization mark:	Heart rate sync mark, pulse rate sync mark, respiratory sync mark

Sound

Sound type:	Alarm, synchronization, click
Alarm sound:	3 types (pips, bing bongs, bong)
Synchronization sound:	Pitch variable for IBP and SpO_2

Alarm

Alarm items:	Upper/lower limits alarm, apnea alarm, arrhythmia alarm, connector disconnection alarm, noise alarm, electrode off alarm, waveform detecting alarm, probe off alarm, cuff/hose check alarm, sensor check alarm, low battery alarm, operating environment alarm
Alarm levels:	Crisis (red blinking), Warning (yellow blinking), Advisory (yellow lighting)
Alarm indication:	Alarm indicator, highlighted message, alarm sound
Alarm suspend:	Provided (for 1 or 2 min)

ECG

Electrode offset potential tolerance:	± 500 mV
Input dynamic range:	± 5 mV
Internal noise:	≤ 20 μVp-p (Refer to input)
Common mode rejection ratio:	≥ 90 dB
Input impedance	≥ 5 MΩ (at 10 Hz)
Input bias current:	≤ 100 nA
Heart rate count	
Calculation method:	Moving average/Instantaneous beat to beat (selectable)
Counting range:	0, 12 to 300 beats/min (±2 beats/min)
Arrhythmia analysis	
Analysis method:	Template matching method
Number of channels:	1 channel
VPC counting rate:	0 to 99 VPCs/min

Arrhythmia message:	ASYSTOLE, VT, VF, VPC RUN, COUPLET, EARLY VPC, BIGEMINY, FREQ VPC, TACHYCARDIA, BRADYCARDIA, NOISE, Electrode OFF, LEARNING
Arrhythmia recall:	
Number of recall files:	16
	With QM-421P flash disk card, 100
Storage time per file:	8 s
ST level measurement:	
Number of measurement channels:	3-electrodes: 1 ch
	6-electrodes: 8 ch
	10-electrodes: 12 ch
Measuring range:	±2.5 mV
Number of recall files (QM-421P flash disk card required):	500 files for monitoring lead
Pacemaker pulse rejection capability:	0.1 to 2 ms, ±2 to 700 mV
	ANSI/AAMI EC 13-1992 compatible
	Pacing pulse detection ON/OFF
Defibrillation-proof:	ECG input protected against 400 J
	IEC 60601-2-27 17.101 compatible
ESU interference filter:	Provided
Time constant:	0.5 or 3.2 s
AC hum filter:	OFF: 150 ±10 Hz (> –3 dB)
	ON: 23 ±3 Hz (> –3 dB)
	≤ –16 dB (50 Hz or 60 Hz)
Lead:	
3-electrode cable:	I, II, III
6-electrode cable:	I, II, III, aVR, aVL, aVF, 2 from V1 to V6
10-electrode cable:	I, II, III, aVR, aVL, aVF, V1 to V6
Waveform display:	
Display sensitivity:	10 mm/mV ±5% (at ×1 sensitivity)
Sensitivity control:	×1/4, ×1/2, ×1, ×2, ×4, or AUTO
Auto positioning:	Available
Pacing spike display:	Available
Heart rate display update cycle:	Every 3 s or when alarm is generated
Alarm items:	
Upper limit range:	20 to 300 beats/min in 5 beats/min steps, OFF
Lower limit range:	OFF, 15 to 295 beats/min in 5 beats/min steps
Alarm items:	TACHYCARDIA, BRADYCARDIA, ASYSTOLE
12 lead ECG interpretation:	Available when monitoring 12 leads on the BSM-4103/4104/4113/4114 monitors.

Respiration (Transthoracic impedance pneumography)

Measuring impedance available range:	0 to 2 kΩ
Internal noise:	≤ 0.2 Ω (Refer to input)
Excitor current:	30 ±10 μArms at 31.25 kHz
Frequency response:	0.1 to 3.2 Hz ±1 Hz (–3 dB)
Respiration counter counting range:	0 to 150 breaths/min
Respiration rate counting accuracy:	±2 breaths/min
Defibrillation proof:	Respiration input protected against 400 J discharge
Waveform display:	
Display sensitivity:	10 mm/Ω ±25% (at ×1 sensitivity)
Sensitivity control:	×1/4, ×1/2, ×1, ×2, ×4

Respiration rate display update cycle: Every 3 s or when alarm is generated
Alarm:
- Upper limit range: 2 to 150 breaths/min in 2 breaths/min steps, OFF
- Lower limit range: OFF, 0 to 148 breaths/min in 2 steps
- Apnea time: OFF, 5 to 40 s in 5 s steps

SpO_2 on BSM-4101/4103/4111/4113 Monitors

Measuring range: 50 to 100%
Pulse rate counting range: 0, 12 to 300 beats/min
SpO_2 accuracy: ±2 digits (80% ≤ SpO_2 ≤ 100%)
±3 digits (50% ≤ SpO_2 < 80%)
SpO_2 display:
- Pulse rate display update cycle: Every 3 s or when alarm is generated
- Sync tone modulation: Change in 20 steps at 81 to 100% SpO_2

Waveform sensitivity: ×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8 or AUTO
Alarm:
- Upper limit range: 51 to 100% SpO_2 in 1% SpO_2 steps, OFF
- Lower limit range: OFF, 50 to 99% SpO_2 in 1% SpO_2 steps

SpO_2 on BSM-4102/4104/4112/4114 Monitors

Measuring range: 1 to 100%
Pulse rate counting range: 0, 12 to 300 beats/min
SpO_2 accuracy: Depends on the probe. Refer to Section 13.
SpO_2 display:
- Pulse rate display update cycle: Every 3 s or when alarm is generated
- Sync tone modulation: Change in 20 steps at 81 to 100% SpO_2

Waveform sensitivity: ×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8 or AUTO
Alarm:
- Upper limit range: 51 to 100% SpO_2 in 1% SpO_2 steps, OFF
- Lower limit range: OFF, 50 to 99% SpO_2 in 1% SpO_2 steps

Non Invasive Blood pressure, NIBP

Measuring method: Oscillometric
Cuff pressure display range: 0 to 300 mmHg
Accuracy: ±3 mmHg (0 mmHg ≤ NIBP ≤ 200 mmHg)
±4 mmHg (200 mmHg ≤ NIBP ≤ 300 mmHg)
Safety:
- Maximum pressurization value cuff inflation limiter: Adult 300 to 330 mmHg
  Neonates 150 to 165 mmHg
- Cuff inflation time limiter: Adult 161 to 165 s
  Neonates 81 to 84 s

Measurement mode: Manual
Continuous
Periodic: 2, 2.5, 5, 10, 15, 30 min, 1, 2, 4, 8 hr interval
NIBP data display update cycle: Updated every measurement
Measurement end sound: Generated when measurement ends
Alarm:
- Upper limit range: 15 to 260 mmHg in 5 mmHg steps, OFF
- Lower limit range: OFF, 10 to 255 mmHg in 5 mmHg steps

Invasive Blood Pressure, IBP

Measuring range:	–50 to 300 mmHg
Measuring accuracy:	±1 mmHg ±1 digit (–50 mmHg ≤ IBP < 100 mmHg)
	±1% ±1 digit (100 mmHg ≤ IBP ≤ 300 mmHg)
Auto zero balancing range:	±200 mmHg
Auto zero balancing accuracy:	±1 mmHg
Transducer sensitivity:	50 µV/V/10 mmHg
Pulse rate counting range:	0, 12 to 300 beats/min
Pulse rate counting accuracy:	±2 beats/min
Noise:	Within ±1 mmHg
Temperature zero drift:	±0.1 mmHg/1°C
Frequency response:	DC to 20 Hz ±3Hz
	DC to 12 Hz ±3Hz
Display update cycle:	Every 3 or when alarm is generated
BP sync sound:	Provided, systolic value 20 to 120 mmHg, changes in 20 steps every 5 mmHg
Alarm:	
Upper limit range:	2 to 300 mmHg in 2 mmHg steps, OFF
Lower limit range:	OFF, 0 to 298 mmHg steps in 2 mmHg steps

Temperature

Measuring range:	0 to 45°C
Measuring accuracy:	±0.1°C (25°C ≤ Temp ≤ 45°C)
	±0.2°C (0°C ≤ Temp < 25°C)
Temperature drift:	within ±0.005°C /°C
Temperature range:	
Display range:	0°C to 45°C (32 to 115°F)
Display update cycle:	Every 3 s
Alarm:	
Upper limit range:	0.1 to 45°C (32 to 113°F) in 0.1°C (1°F) steps, OFF
Lower limit range:	OFF, 0 to 44.9°C (31 to 112°F) in 0.1°C (1°F) steps

Cardiac Output, CO

Measuring method:	Thermodilution method
Measuring range:	
Injectate temperature (Ti):	0°C to 27°C
Blood temperature (Tb):	15°C to 45°C
Thermodilution curve (delta Tb):	0°C to 2.5°C
Cardiac output (CO):	0.1 to 20 L/min
Measuring accuracy:	
Ti:	±0.2°C
Tb 25 to 45°C:	±0.1°C
Tb 15 to 25°C:	±0.2°C
CO:	±5%
Temperature drift:	
Ti:	±0.005°C /°C
Tb:	±0.005°C /°C
Frequency response (delta Tb):	DC to 3 Hz (–3 dB)
Injectate volume range:	3, 5, 10 mL (7F)
	1, 2, 3, 4, 5 mL (5F)

Respiration (Thermistor method)

Respiration rate counting range:	0 to 150 breaths/min
	Apnea, 5 to 40 s
Accuracy:	±2 breaths/min
Noise:	Within 2.5 Ω (Refer to input)
Frequency response:	0.1 to 3 Hz (–3 dB)
Waveform display	
Display sensitivity:	10 mm/100 Ω ±10% (at ×1 sensitivity)
Sensitivity control:	×1/4, ×1/2, ×1, ×2, ×4
Respiration rate display update cycle:	Every 3 or when alarm is generated
Alarm:	
Upper limit range:	2 to 150 breaths/min in 2 breaths/min steps, OFF
Lower limit range:	OFF, 0 to 148 breaths/min in 2 breaths/min
Apnea time:	OFF, 5 to 40 s in 5 s steps

Inspired Oxygen Fractional Concentration, FiO_2

Measuring range:	10 to 100% O_2
Accuracy:	±3% full scale (When calibrated at 21% O_2)
	±2% full scale (When calibrated at 100% O_2)
Temperature drift:	±0.12% O_2/°C
FiO_2 display update cycle:	Every 3 s or when alarm is generated
Alarm:	
Upper limit range:	19 to 100% in 1% steps, OFF
Lower limit range:	OFF, 18 to 99% in 1% steps

Expired Carbon Dioxide Tension, CO_2

For the TG-900P/TG-950P CO_2 sensor kit specifications, refer to the kit manual.

Measuring method:	Mainstream (TG-900P: semi quantitative, TG-950P: quantitative)
CO_2 measuring range:	0 to 99 mmHg
CO_2 measuring accuracy:	
TG-900P:	±4 mmHg ($0 \leq CO_2 \leq 40$ mmHg)
	±10% reading ($40 < CO_2 \leq 76$ mmHg)
	(When 1 atmospheric pressure, air inspiration, no condensation)
TG-950P:	±2 mmHg ($0 \leq CO_2 \leq 40$ mmHg)
	±5% reading ($40 < CO_2 \leq 70$ mmHg)
	±7% reading ($70 < CO_2 \leq 100$ mmHg)
	(When no condensation, BTPS (body temperature 37°C, ambient pressure, saturated with vapor))
Warm-up time:	5 s (minimum)
Response time	
TG-900P:	200 ms (typical) for steps from 10 to 90%
TG-950P:	60 ms (typical) for steps from 10 to 90%, delay time 100 ms ±10 ms
Respiration rate counting range:	TG-900P: 3 to 60 breaths/min
	TG-950P: 0 to 150 breaths/min
Respiration rate counting accuracy:	±2 breaths/min
CO_2 value display update cycle:	Every 3 s or when alarm is generated
Alarm:	
Upper limit range:	2 to 99 mmHg in 1 mmHg in 1 steps, OFF
Lower limit range:	OFF, 1 to 98 mmHg in 1 steps
Apnea time:	OFF, 5 to 40 s

Trendgraph

Trend parameters:	Heart rate (or pulse rate), respiration rate, VPC rate, ST level, EVENT, apnea (time), apnea (frequency), SpO_2, NIBP (systolic, diastolic and mean), IBP (systolic, diastolic and mean), temperature, CO_2 and FiO_2
Trend times:	1, 2, 4, 8, and 24 h

Vital Signs List

Parameters:	Heart rate (or pulse rate), VPC rate, ST level, NIBP (systolic, diastolic and mean), SpO_2, IBP (systolic, diastolic and mean), respiration rate, temperature, CO_2 and FiO_2
Number of files in list:	Periodic vital signs list: 120
	Entries in vital signs list at NIBP measurement: 120
List interval:	Periodic vital signs list: 1, 5, 15, 30 or 60 minutes
	Vital signs list at NIBP measurement: at NIBP measurement

Hemodynamics List (BSM-4103/4104/4113/4114 monitors only)

Number of files:	8

Full Disclosure (QM-421P flash memory card required)

Storage time:	48 hours

Alarm History

Number of files:	200

ECG/BP Output

Output impedance	
ECG:	≤ 100 Ω
BP:	≤ 100 Ω
Output-waveform	
ECG:	±5.0 V (at 1 mV/V sensitivity)
BP:	–0.5 to +3.0 V(at 100 mmHg/V sensitivity)
Heart rate Trigger:	Open collector output
Frequency response	
ECG:	0.05 to 23 Hz (> –3 dB)
	(Differ in ECG display mode setting)
BP:	≥DC to 20 Hz (> –3 dB)
Sensitivity accuracy	
ECG:	±5%
BP:	±5% (Exclude offset)
Delay	
ECG:	Hum filter off: approx. 2 ms
	Hum filter on: approx. 10 ms
BP:	20 Hz filter: approx. 30 to 35 ms max
HT:	approx. 32 to 64 ms max

Recorder (BSM-4101/4102/4103/4104 monitors only)

Recording method:	Thermal array recording
Number of channels:	3 traces (maximum)
Recording width:	≥48 mm

Paper speed:	25, 50 mm/s
Recording paper:	FQW-50-3-100

External Output

ZB-800PG/PK:	Provided
External monitor:	Provided

Power Requirement

Line voltage:

BSM-4100A:	AC 117 V ±10%
DC (NKB-101):	10.8 to 16.0 ±5%
Line frequency:	50 or 60 Hz ±2%
Power consumption:	AC: 80 VA maximum
	DC: 50 W maximum

Clock Accuracy

At operating temperature 25°C:	about ±2 min 40 s/month maximum
At storage temperature –20 to 60°C:	about ±5 min/month maximum

Environment

Operating environment

Temperature:	10 to 40°C
Humidity:	30 to 90% RH (0 to 40°C, non-condensing)
Atmospheric pressure:	68 to 106 kPa

Storage environment

Temperature:	–20 to +65°C
	–15 to +55°C (Recording paper)
Humidity:	15 to 95% RH (0 to 40°C, non-condensing)
Atmospheric pressure:	68 to 106 kPa

Dimensions and Weight (approximate)

Dimensions:	339 mm W × 375 mm H × 159 mm D
Weight:	9 kg (excluding battery)

Electromagnetic Compatibility

IEC60601-1-2 (1993) – Collateral Standard: Electromagnetic compatibility – Requirement and tests

Emissions:	CISPR11 Group 1, Class B

Safety Standard

Safety standard:	IEC 60601-1 (1988) Amendment 1 (1991), Amendment 2 (1995)
	IEC 60601-2-27 (1994) - Particular requirements for the safety of electrocardiographic monitoring equipment
	IEC 60601-2-25 (1993)/NS 1231 (1995) - Particular requirements for the safety of electrocardiographs
	IEC 60601-2-30 (1995) - Particular requirements for the safety of automatic cycling indirect blood pressure monitoring equipment

According to the type of protection against electrical shock:

CLASS I EQUIPMENT (AC Powered)

Internally Powered EQUIPMENT (BATTERY Powered)

According to the degree of protection against electrical shock

ECG, Respiration (impedance), IBP:	Defibrillator-proof type CF applied part
Temperature, CO:	CF applied part
NIBP:	Defibrillator-proof type BF applied part
SpO_2, Respiration (thermistor), CO_2, FiO_2:	BF applied part

According to the degree of protection against harmful ingress of water:
IPX0 (ordinary EQUIPMENT)

According to the degree of safety of application in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE:
Equipment not suitable for use in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE

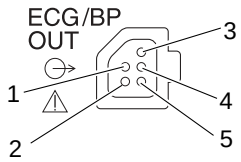
According to the mode of operation: CONTINUOUS OPERATION

Input/Output Socket Pin Assignment

WARNING

Connect only the specified instruments to the connector or sockets marked with ⚠ by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.

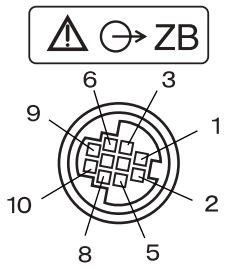
ECG/BP OUT Socket



<Connection Cable>
ECG/BP output cable Model YJ-910P (5 m)
ECG/BP output cable Model YJ-920P (0.3 m)
<Pin Assignment>

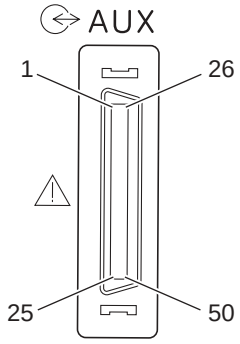
Pin No.	Signal	Cable Color
1	GND	black
2	SHIELD	wire
3	BP OUT	green
4	HT OUT	red
5	ECG OUT	white

ZB Socket



Pin No.	Signal	Pin No.	Signal
1	+5V	6	HW
2	E2	7	RxDTLA
3	+8V	8	TxDTLA
4	E1	9	CLK
5	ECGTLA	10	XRESET

AUX Socket



Pin No.	Signal	Pin No.	Signal
1	E2	26	E2
2	RESERVE 01	27	RESERVE 02
3	RESERVE 03	28	RESERVE 04
4	RESERVE 05	29	RESERVE 06
5	RESERVE 00	30	RESERVE 00
6	E2	31	E2
7	NC	32	NC
8	E2	33	E2
9	RESERVE 07	34	RESERVE 08
10	RESERVE 09	35	RESERVE 10
11	E2	36	E2
12	RESERVE 11	37	RESERVE 12
13	E2	38	RESERVE 13
14	RESERVE 14	39	RESERVE 15
15	RESERVE 16	40	RESERVE 17
16	RESERVE 18	41	NC
17	RESERVE 19	42	RESERVE 20
18	E2	43	E2
19	RED	44	GRET
20	RRET	45	GREEN
21	BLUE	46	E2
22	BRET	47	HSYNC
23	E2	48	E2
24	E2	49	VSYNC
25	E2	50	E2

General Requirements for Connecting Medical Electrical System

When more than one electrical instrument is used, there may be electrical potential difference between the instruments. Potential difference between instruments may cause current to flow to the patient connected to the instruments, resulting in electrical shock (micro shock). Therefore, electrical instruments must be appropriately installed as specified in IEC60601-1-1.

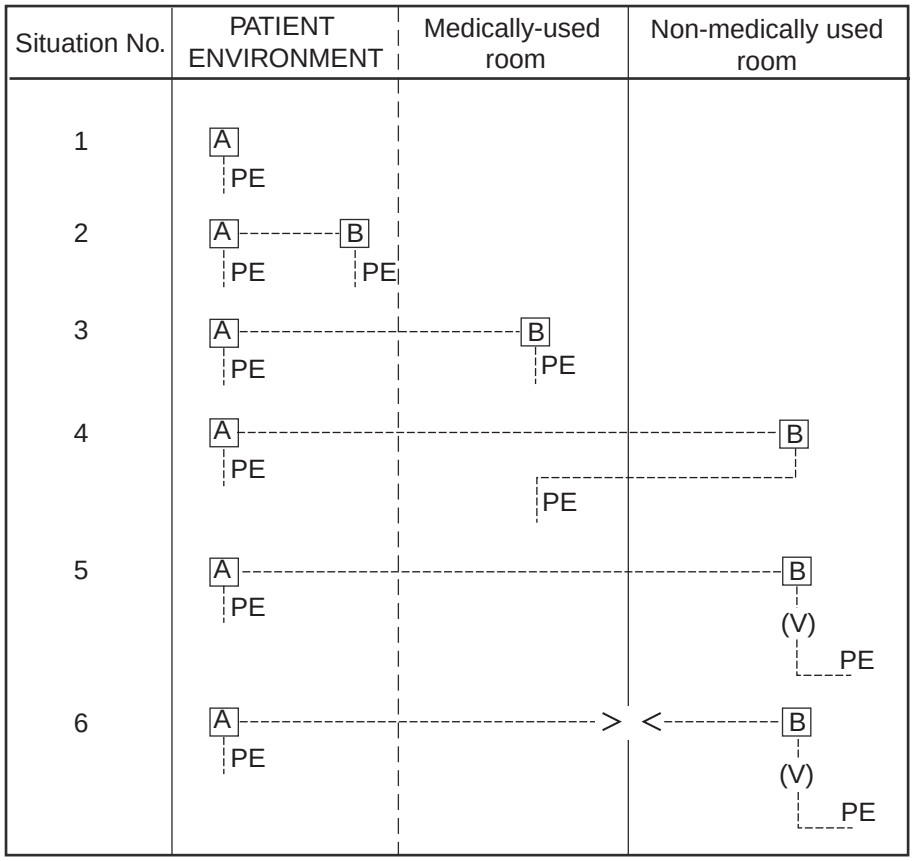
The following is an extract from IEC60601-1-1 “Medical electrical equipment Part 1: General requirements for safety”. For details, refer to IEC60601-1-1 and consult with a biomedical engineer.

Examples of combinations of MEDICAL ELECTRICAL EQUIPMENT and non-medical electrical equipment

Situation No.	Equipment A	Equipment B	Solution
1	IEC 60601/X		OK
1a	IEC XXXXX		OK, if ENCLOSURE LEAKAGE CURRENT is less than 0.5 mA. If the ENCLOSURE LEAKAGE CURRENT is more than 0.5 mA: Solution *Q* (separating transformers).
2a	IEC 60601/X	IEC 60601/B	OK
2b	IEC 60601/F	IEC XXXXX	for B any one of *P*, *Q*, *R*
2c	IEC 60601/B	IEC XXXXX	for A solution *P* for B any one of *P*, *Q*, *R*
3a	IEC 60601/X	IEC 60601/B	OK
3b	IEC 60601/F	IEC XXXXX	OK
3c	IEC 60601/B	IEC XXXXX	for A solution *P*
4	See 3a, 3b, 3c		
5a	IEC 60601/X	IEC 60601/B	for A solution *P* or *S* (groundloop possible)
5b	IEC 60601/X	IEC XXXXX	for A solution *P* or *S* (groundloop possible)
6a	IEC 60601/X	IEC 60601/X	OK (with *S*)
6b	IEC 60601/X	IEC XXXXX	OK (with *S*)

IEC 60601/B = IEC 60601-1 EQUIPMENT of TYPE B **with** PATIENT connection
IEC 60601/F = IEC 60601-1 EQUIPMENT of TYPE BF or TYPE CF (or TYPE B **without** PATIENT connection)
IEC 60601/X = IEC 60601-1 EQUIPMENT of TYPE B or TYPE BF or TYPE CF
IEC XXXXX = Equipment complying with e.g. IEC 348, IEC 950 etc.

P: additional protective earth
Q: additional separating transformer
R: floating power supply
S: separation



Legend:

(V) = Potential difference between different localities.

>< = SEPARATION DEVICE.

PE = Protective earth.

Standard Accessories

NOTE

- **Use only Nihon Kohden specified parts and accessories to assure maximum performance from your instrument.**
- **When ordering the following accessories, specify the supply code no. When the supply code no. is not provided with the accessory, specify the code no.**

Name	Qty	Code no.	Supply Code no.
Power cord UL	1	505312	—
Touch pen	1	577297	—
ECG connection cord (3/6 leads)	1	JC-906PA	K922A
ECG electrode lead (3 leads)	1	BR-903PA	K911A
SpO_2 connection cord for BSM-4102/4112/4104/4114*	1	OEM-10	—
Air hose for adults/children (3.5 m)	1	YN-901P	S902
Cuff for adults	1	YP-963T	S944B
Cuff for children	1	YP-962T	S943C
BSM-4101/4102/4103/4104 monitors only			
Thermal head cleaner pen	1	404617	Y011
Recording paper	1	FQW50-3-100	A723

* Only for the BSM-4102/4112/4104/4114 monitors with a “Nellcor OxiMax™” label on the socket panel

Options and Consumables

NOTE

When ordering the following options/consumables, specify the supply code no. When the supply code no. is not provided with the options or consumables, specify the model or code no.

Options for the Monitor

Name	Qty	Code No.	Supply Code No.
Grounding lead	1	544582	—
Fuse T2.0 A/250 V	1	104522	—
Battery pack	1	NKB-101	—
Transmitter	1	ZB-800PA*	—
Cart	1	KC-009P	—
Flash disk card	1	QM-421P	—
Network card	1	QI-101P	—
Network printer card	1	QI-111P	—
Wireless LAN Station	1	QI-410P	—
Multigas unit	1	AG-920RA	—
CNIBP unit	1	AP-400RA	—
Connection cable	1	YJ-921P	—
Interface	1	QI-401P	—
Interface for BIS monitor	1	QI-402P	—
Interface for Drager ventilator	1	QI-403P	—
Interface for Servo300 ventilator	1	QI-404P	—
Interface for Oridion Microcap	1	QI-405P	—
Interface for Puritan Bennett ventilator	1	QI-406P	—
Interface for Siemens ventilator Servo i	1	QI-408P	—
BSM/WEP-4000 RGB cable	1	YS-072P5	—
Thermal head cleaner pen	1	404617	Y011
Recording paper	1	FQW50-3-100	A723

* The ZB-800P transmitter is 400MHz only.

For ECG and Respiration (Impedance Method) Monitoring

Name	Purpose	Length (m)	Qty	Code No.	Supply Code No.
Electrode lead	3 electrodes (AHA) (Clip type)	0.8	1	BR-903PA	K911A
	3 electrodes (AHA) (Snap type)			BR-913PA	K910B
	6 electrodes (AHA)			BR-906PA	K912A
	6 electrodes (AHA) (Snap type)			BR-916PA	K915A
ECG connection cord	3/6 electrodes (AHA)	3		JC-906PA	K922A
	10 electrodes (AHA)			JC-900PA	K921A
ECG patient cable	10 electrodes (AHA)	3.8		BJ-900PA	K901A
ECG/BP output cable	Connects to other equipment for signal output	5	1	YJ-910P	K974
	Connects to other equipment for signal output, horn jack type	0.3		YJ-920P	K975

For Respiration Monitoring (Thermistor method)

Name	Length (m)	Qty	Code No.	Supply Code No.
Respiration pickup for nose	3	1	TR-900P*	P901
Respiration pickup for airway	3	1	TR-910P	P902
Airway adapter	—	1	YG-001P	V911

* This part has not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

For SpO_2 Monitoring (BSM-4101/4103/4111/4113 monitors only)

Name	Length (m)	Qty	Code No.	Supply Code No.
SpO_2 connection cord	2.5	1	JL-900P	K931
Finger probe	1.6		TL-201T	P225F
			TL-101T	P224A
Multi-site probe			TL-120T	P225C
Foot probe			TL-121T	P225D
Disposable probe (For adults)		5	TL-251T	P201A
Disposable probe (For children)			TL-252T	P201B
Disposable probe (For neonates)			TL-253T	P201C
Disposable probe (For adults and neonates)	0.8		TL-051S	P228A
	1.6		TL-052S	P228B
Disposable probe (For adults, children and infants)	0.8		TL-061S	P229A
	1.6		TL-062S	P229B
COTTONY tape	—	20	340703	P259
Foam tape for TL-051S/052S/061S/062S disposable probes		4 × 25	—	P260

NOTE

The Nellcor probes and cables are available direct from Nellcor Puritan Bennett or their suppliers.

For NIBP Monitoring

Name		Width (cm)	Length (m)	Qty	Code No.	Supply Code No.
Air hose for adults/children		—	1.5	1	YN-900P	S901
			3.5		YN-901P	S902
Extension air hose			1.5		YN-990P	S903
Cuff for infants		5	0.15		YP-960P	S943A
Cuff for children	Small	7			YP-961T	S943B
	Standard	10			YP-962T	S943C
Cuff for adult	Standard	13			YP-963T	S944B
	Large	15			YP-964T	S944C
Cuff for thigh		19			YP-965T	S944D
Cuff for infants		5	0.15		YP-950T*	S939A
Cuff for children	Small	7			YP-951T*	S939B
	Standard	10			YP-952T*	S939C
Cuff for adult	Standard	13			YP-953T*	S940B
	Large	15			YP-954T*	S940C
Cuff for thigh		19			YP-955T*	S940D
Disposable cuff for infants		6	0.2	20	YP-910P	—
Disposable cuff for children		9			YP-912P	—
Disposable cuff for adults	Small	12			YP-913P	—
	Standard	14			YP-914P	—
	Large	16			YP-915P	—
	Extra large	20			YP-916P	—
Air hose for neonates		—	1.5	1	YN-920P	S904
			3.5		YN-921P	S905
Disposable cuff for neonates	#20	2.5	0.15	10	YP-920P	—
	#21	3			YP-921P	—
	#22	4			YP-922P	—
	#23	5			YP-923P	—
Sterilized disposable cuffs for neonates		3	0.21	1	No. 11**	S260
		4			No. 12**	S260A
		5			No. 13**	S260B

CAUTION

*** These Products Contain Natural Rubber Latex Which May Cause Allergic Reactions.**

** These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

For IBP Measurement

Nihon Kohden and Becton Dickinson (Ohmeda) Reusable Transducers

Name	Length, Description	Qty	Code No.	Supply Code No.
IBP connection cord	For P23XL-1, P10EZ-1 and Becton Dickinson (Ohmeda) transducers, 3.5 m	1	JP-900P	K951
IBP connection cord	For TP-400T and Becton Dickinson (Ohmeda) transducers, 0.3 m	1	JP-910P	K952
IBP transducer	—	1	TP-400T*	—
IBP transducer	—	1	P23XL-1	—
IBP transducer	—	1	P10EZ-1	—
Dome	With membrane	25	TY-410U*	S511
Monitoring kit	For P23XL-1 and TP-400T	5	SCK-520*	—
Monitoring kit	For P10EZ-1, arm mount	5	SCK-512*	S570
Monitoring kit	For P10EZ-1, pole mount	5	SCK-560*	S572
Dome	Without membrane	1	TA-1011*	—
Dome	With membrane	12	TA-1011D*	—
Super dome	—	10	TA-1015T	—
Dome	With membrane, rotatory luer lock	12	TA-1010ND	—
Dome	With membrane	12	TA-1019	—
Dome	With membrane	12	TA-1019M	—
Super dome	—	10	TA-1017	—
Super dome	—	10	TA-1017M	—
Super dome	—	10	TA-1018	—
Criti flo	—	10	TA-4004	—
Criti flo	—	10	TA-4005*	—
Transducer holder	For TP-400T	1	ZY-101U*	S238
Adapter 2	For P23XL-1, used with ZY-101U	1	—	S239
Pressure tubing	15 cm	25	PT-06	—
Pressure tubing	30 cm	25	PT-12	—
Pressure tubing	60 cm	25	PT-24	—
Pressure tubing	90 cm	25	PT-36	—
Pressure tubing	120 cm	25	PT-48	—
Pressure tubing	150 cm	25	PT-60	—
Microchip pressure transducer	—	1	SPC-370*	—
Connection cable	For SPC, 1.5 m	1	TEC-5C*	—
Connection cable	For SPC, 3 m	1	TEC-10C*	—
Control unit	For SPC	1	TC-510*	—

* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Becton Dickinson (Ohmeda) Disposable Transducers

Name	Length, Description	Qty	Code No.	Supply Code No.
IBP connection cord	3.5 m	1	JP-900P	K951
IBP connection box	2.7 m, for 4 channels	1	JP-940P	—
Monitoring kit	For cerebral pressure	10	DX-100*	—
Monitoring kit	For neonates	10	DX-200*	—
Monitoring kit	With flush device	10	DX-300*	—
Monitoring kit	For arm mounting	5	DX-312*	—
Monitoring kit	For pole mounting	5	DX-360*	—
Monitoring kit	For pole mounting	5	DX-360R*	—
Monitoring kit	For triple line	3	DX-360TT*	—
Monitoring kit	For pole mounting	5	DX-360SD*	—
Monitoring kit	For double line	5	SCKD-5005*	S568
Transducer fixing plate	—	1	TBG2	—
Transducer fixing plate	—	1	TMM	—
Transducer fixing plate	—	1	UMM	—
Safe needle	For DX-360SD	50	TA-BPN*	—
Arterial blood sampler	For TA-BPN	100	QS-90*	T200A

* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Baxter Disposable Transducers

Name	Length, Description	Qty	Code No.	Supply Code No.
IBP connection cord	For Baxter transducers, 3.5 m	1	JP-920P	L901

Baxter blood pressure transducers are available direct from Baxter Healthcare Corporation (www.baxter.com) or their suppliers.

Other

Name	Length, Description	Qty	Code No.	Supply Code No.
Catheter	For cerebral pressure measurement	1	TM-200T*	S380
Pressure bag	—	1	ACS-222*	S160
Disposable 3-way stopcock	—	50	318434*	S180
3-way stopcock	3 core	1	MF-3F*	S314
3-way stopcock	5 core	1	MF-5F*	S315
Holder	For 5 core stopcock	1	—	S226
ECG/BP output cable	Connects to other equipment for signal output (5 m)	1	YJ-910P	K974
	Connects to other equipment for signal output (0.3 m, horn jack type)	1	YJ-920P	K975

* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

For Temperature Monitoring

Name	Purpose	Length (m) Thickness (F)	Qty	Code No.	Supply Code No.
Temperature connection cord	For reusable probe/disposable probe	0.3 m	1	JT-900P	K961
Thermistor probe	For adult rectum	3.5 m	1	YSI-401JG*	P240A
	For child rectum			YSI-402JG*	P241A
	Disc type			YSI-409JG*	P242A
Probe cover	For YSI-401JG	—	10	—	P249
Temperature insulation pad	For YSI-409JG		5 dozens		P252

* These thermistor probes are available direct from YSI, Yellow Springs Instrument CO., Inc., Yellow Springs Ohio 45387, USA; Phone +1 513-767-7241.

The temperature disposable probes are available direct from Kendall Healthcare Products Company (www.kendallhq.com) or their suppliers.

For CO_2 Monitoring (Mainstream Method)

Name	Length (m)	Qty	Code No.	Supply Code No.
CO_2 sensor kit (CO_2 adapter + CO_2 sensor) for the semi quantitative method	3	1	TG-900P	P903
CO_2 adapter for TG-900P	2	1	JG-900P	K981
CO_2 sensor for TG-900P	1	1	TG-101T	—
Airway adapter for TG-900P	—	50	YG-101T	R801
CO_2 sensor kit (CO_2 adapter + CO_2 sensor) for quantitative method	4	1	TG-950P	—
CO_2 adapter for TG-950P	2	1	JG-950P	—
CO_2 sensor for TG-950P	2	1	TG-201T	—
Airway adapter for adult and children (Weight 10 kg), TG-950P	—	30	YG-201T	R802
Airway adapter for children and neonates (Weight 3 to 10 kg), TG-950P	—	30	YG-202T	R803

For FiO_2 Monitoring

Name	Length (m)	Qty	Code No.	Supply Code No.
FiO_2 connection cord	3	1	JO-900P	K941
O_2 sensor	0.6	1	074705*	P911
T shaped adapter	—	1	110774*	V912

* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

For CO Monitoring

Name	Measuring Method and Catheter	Length (m)	Qty	Code No.	Supply Code No.
CO connection cord	Bath probe and inline sensor methods	2.0	1	JT-950P	K962
CO extension cable	Any catheter	1.0	1	SP-4035-1	—
Bath probe	Any catheter, bath probe method	1.5	1	SP-5030	—
Inline sensor	Becton Dickinson (Ohmeda) catheter inline sensor method	—	25	SP-5045	—
Inline sensor connection cable			1	SP-4045	—
Inline iced injectate kit			4	SP-4500	—
Injectate cooling ice container (for injectate kit)			1	SP-5500	—
Injectate supply system (for cooling)	Baxter catheter inline sensor method	—	4	93-600*	—
Injectate supply system (for room temperature)			4	93-610*	—
Flow through injectate housing			8	93-505*	—
Injectate supply system (thermistor probe for Nihon Kohden monitors)			1	93-528*	—
Life kit	Bath probe and inline sensor methods	—	5	DX-336DT*	—

* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Becton Dickinson (Ohmeda) Catheter

Code No.	Specifications	Thickness (F)	Lumen	Total length (m)	Qty	Supply Code No.
TC-504*	—	5	4	0.8	1	—
TC-664MP*	Made of polyurethane	6		1.1		—
TC-704*	—	7				—
TC-704M*	—					—
TC-704MU*	Soft type					—
TC-7042*	For inline sensor method					—
TC-724*	S shaped tip					—
TC-755*	—	7.5	5			—
TC-774MP*	Made of polyurethane	7	4			—

* These parts have not been checked for compliance with the MDD (Medical Device Directive). For EC member countries, Nihon Kohden recommends the use of parts that comply with MDD.

Baxter Catheter

Baxter catheters are available direct from Baxter Healthcare Corporation (www.baxter.com) or their suppliers.